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A

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A COMPARISON OF MANAGEMENT PRACTICES AND ECONOMIC IMPORTANCE OF MOOSE, MUSKRAT, HARE AND PTARMIGAN IN ALASKA AND FINLAND

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ABSTRACT

This work presents a review of the management organizations, basic research, common management practices and the economic importance of game animals common to both Alaska and Finland. Environmental differences provide some special problems--for example, the seasonal migration of moose in Alaska and moose damages in pine forests in Finland. Generally the emphasis of management in Alaska is in favor of big game, although basic research on small game is already extensive. In Finland, small game has received more attention in research and management than the few big game species.

In Alaska, game management is primarily the responsibility of professional biologists within the Alaska Department of Fish and Game, and several federal agencies cooperate. The Finnish system is defined by law but is based on the voluntary cooperation of sportsmen. On the lowest level, in the game management association, there are no full-time employees.

Both organizations are financed by funds collected from hunting licenses, and, in addition, in Alaska by Federal Aid in Wildlife Restoration funds and big game tag revenues. In Finland, moose permit funds are used partly to compensate for moose damages, but the surplus is not restricted to wildlife management uses.

In Alaska, wildlife resources are extremely important for people who hunt for subsistence. Sport hunting, although increasing, is of secondary importance. In 1968, about 17% of the resident population had hunting or trapping licenses. Hunter density was 0.04 hunters/km^2. In Finland, by 1953 some 77% of hunters were sport hunters. In 1968, 3.8% of the total population obtained licenses, and the hunter density was 0.5 hunters/km^2.

PREFACE

The primary purpose of this work is to describe the function of two different game management systems which deal with similar environmental problems existing in boreal and arctic regions. The emphasis is on the Finnish system because there are few papers describing the Finnish system in some detail.

This study was financed by a graduate award from the Alaska Cooperative Wildlife Research Unit. Travel expenses were covered by a Fulbright-Hays travel grant from the U. S. Department of State administered through the U. S. Educational Foundation in Finland. The study was done during my leave of absence from the Department of Agricultural and Forest Zoology, University of Helsinki, Finland. To these agencies and institutions I want to express my sincere gratitude.

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Without the assistance of several people it certainly

would have been difficult to have covered many aspects of this study. I would like to express my thanks to Messrs. Robert Hinman, Oliver Burris and John Burns, Alaska Department of Fish and Game, Fairbanks, for their willingness to assist me. Most of the material received by correspondence from Finland was delivered via the Central Organization of Hunters by Dr. Teppo Lampio and Mr. Tauno Rajanto. Dr. Matti Helminen, State Game Research Institute, and Mr. Tauno V. Mäki, Director, Bureau of Fisheries and Game, Ministry of Agriculture, provided information of special interest. I want to thank collectively all persons in both Alaska and Finland who contributed information for this work.

I am especially grateful to Miss Carol A. Ericson, a fellow graduate student, who retained her jovial attitude under the heavy burden of reviewing and correcting my English during the preparation of the manuscript.

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INTRODUCTION

Alaska and Fennoscandia (the Scandinavian Peninsula, Finland and Soviet Karelia) as entities have very few differences between them. Latitude, topography, climatic and biogeographic features are quite similar. Alaska has a climate with slightly greater extremes in the Interior and the arctic areas than that of Fennoscandia. The fauna and flora include many circumpolar species or closely related races. General vegetational patterns are very similar. The major differences are between tree species with the dominant form in the arctic and subarctic regions of Fennoscandia being scotch pine, Pinus silvestris, while in Alaska black spruce, Picea mariana, and white spruce, Picea glauca, prevail.

Finland lies roughly between 60° and 70° N., which corresponds in Alaska to the distance from Seward on the Kenai Peninsula in the south to the shores of the Arctic Ocean on the north (Fig. 1). Finland lacks major mountain ranges; the fells of Lapland are only from 500 to 1,300 meters high. However, this elevation is enough to form a barrier against the polar high pressure area and northern winds. The warming effect of the Gulf Stream makes the northernmost part of Lapland warmer than eastern Finland at approximately 65° N. In the north Pacific the Kuroshivo

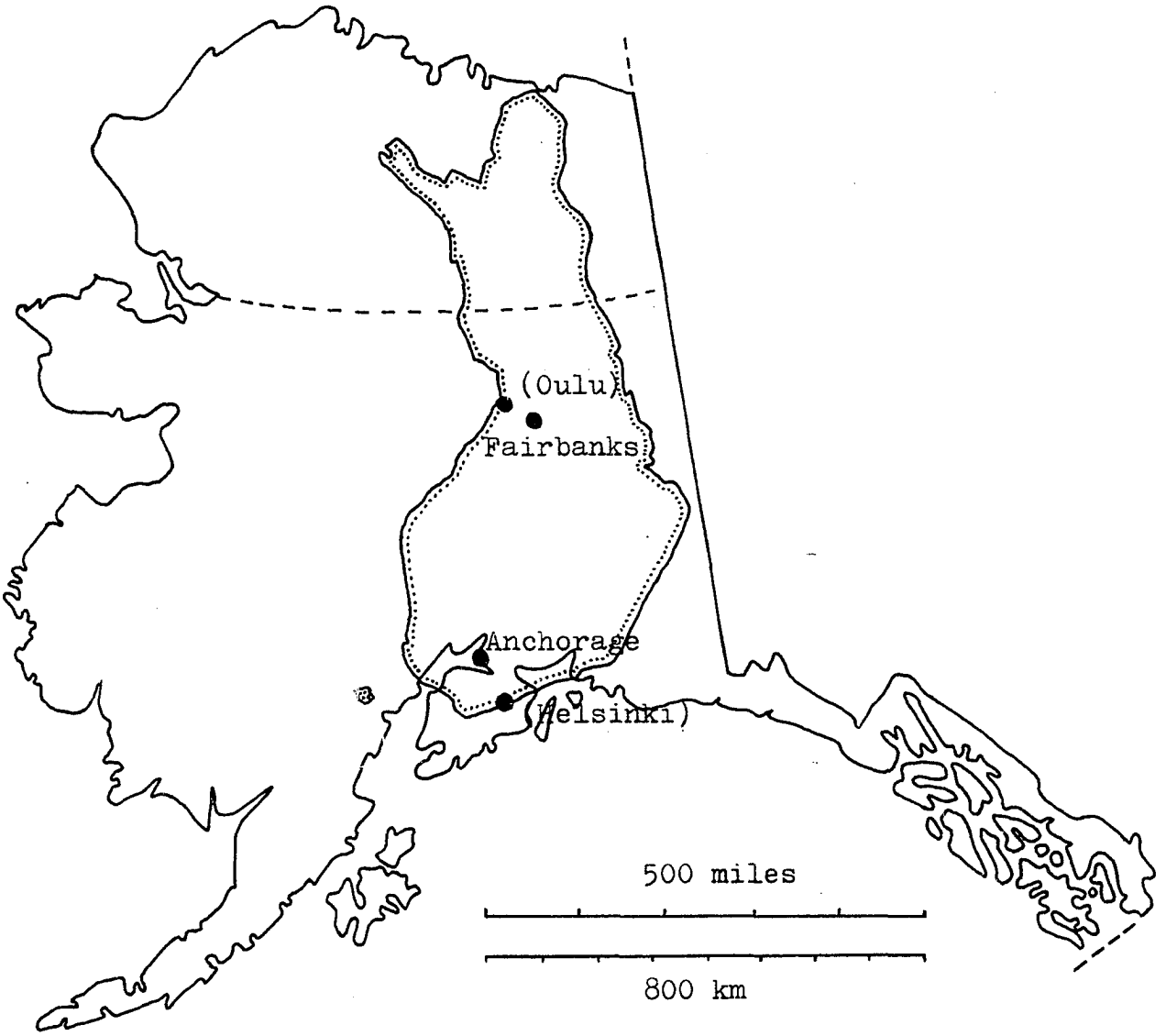

Fig. 1. The latitudinal position of Finland in comparison with Alaska.

current turns southward, and its warming effect is observed along the coastal areas of southern and southeastern Alaska. The climate in the vast interior of Alaska is more subject to continental extremes than anywhere in Finland.

The area of Alaska is 1,500,160 km^2 (586,000 sq. miles) compared with 337,000 km^2 (131,640 sq. miles) for Finland (Keating 1969, Rekola 1969). According to Keating (op. cit) the number of inhabitants in Alaska is about 280,000, of which 53,000 are natives. Almost 50% of the population is concentrated into the area of greater Anchorage. The rapidly growing Fairbanks area in the Interior has some 48,000 inhabitants.

The population of Finland is about 4.7 million, with about 50% living in urban areas (Rekola 1969). The population is concentrated into the south and southwestern part of the country, so that the area southwest of a line from Tornio to Joensuu is usually called "culture Finland" and the sparsely inhabited area north and eastward from this line is thus "nature Finland." There are some 2,000 Lapps, the only ethnic group at least partly comparable to the Alaskan natives, living in the Finnish territory.

The basic industries of Finland have for a long time been agriculture and forestry. During the rebuilding period after World War II industrialization was rapid, and many new sectors were not based on forestry. Agriculture has become more and more mechanized and thus gives liveli-

hood to a considerably smaller number of inhabitants than before the wars (Sømme 1960).

In Alaska industries related to fish and wildlife are of major importance (Buckley 1957, University of Alaska 1969). Recent discoveries of petroleum along the arctic coast may, however, drastically change the relative importance of major industries (see University of Alaska 1968, 1969).

The economy of the natives is still primarily based on fishing, hunting and trapping. Increasing demands for outdoor recreation may in the future exert at least some seasonal effects on this native way of living (Kozely 1964).

The purpose of this work is to present a review of basic research in game biology, the current management practices, and also, to some extent, to compare the economic importance in Alaska and Finland of the moose (Alces alces), the muskrat (Ondatra zibethicus), the hare (Lepus americanus, L. othus, L. timidus and L. europaeus) and the ptarmigan (Lagopus lagopus and L. mutus). Comparisons will also be made especially when the management practices and the economic role of these species are affected by different environmental conditions. Finally, differences in general policies and philosophies adopted and expressed by the people of these two states will be considered.

MATERIAL AND METHODS

This work is based largely on information obtained from published sources. Mimeographed and unpublished reports are also of major importance. The following series of reports which have only limited distribution have been referred to extensively:

> Alaska Department of Fish and Game; Federal Aid in Wildlife Restoration, Annual Project Segment Reports 1963-1969, Juneau, Alaska.
>
> U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife; Kenai National Moose Range, refuge narrative reports 1961-1968, Kenai, Alaska.
>
> Finnish State Game Research Institute; annual progress reports 1964-1968, Helsinki, Finland.
>
> The Central Organization of Hunters; annual progress reports 1964-1967, Helsinki, Finland.

Current information has also been obtained by correspondence.

A major problem of this study has been how to estimate the monetary value of game meat when market prices are often not available. This is especially the case with game meat in Alaska because market hunting and sale of game meat, with a few exceptions, is prohibited by law. (An exception which applies to this work is that the meat of hares may be purchased, sold or bartered as described in section 81.200A of the Alaska hunting, trapping and guiding regulations.) Thus, for the Alaskan situation, the criteria for meat value

are based on previously used estimates; for hares and ptarmigan those presented by Koontz (1968) have been used, and the value of moose meat is calculated on the basis of the unit price given by Steinhoff (1969). The annual increase of the cost-of-living index based on consumer prices has been averaged as 4% a year, using the level of 1964 as the starting point. The unit prices in 1964 are given the value of 100, so that the average index in 1968 is thus 117. When an index based on all items is used there is a source of error because of the different rates of increase of the special indexes for food, medical costs and miscellaneous services. Also during the last two years the average rate of increase has been about 5% a year, and, for instance, the specific index for meat, fish and poultry increased 6.5% in the Anchorage area from October 1968 to October 1969 (Bureau of Labor Statistics 1969). The nationwide consumer price index based on all items increased during the period 1964-1968 from 106.7 to 123.7 (Molony 1970, Table A 66).

Fur prices were obtained from various reports and publications (Koontz 1968, Burris 1969).

Market hunting and the sale of game meat is very restricted in Finland. The marketing of moose meat and ptarmigan, however, is extensive enough to provide standard unit prices. The increase of the unit price for moose meat reflects the general increase in cost of living. The value of hare meat, which is based on a 1969 estimate, is adjusted

to follow the same rate of increase. Because ptarmigan showed quite a wide fluctuation in unit price, the gross average for the whole compilation period is used.

Indirect values, like the expenditures in recreational hunting, are largely omitted here. For Alaska, this aspect is covered in detail by Buckley (1957) and for a limited area, the Kenai National Moose Range, by Steinhoff (1969).

For Finland, the studies available deal mainly with the role of hunting and game-related income and its importance in various parts of the country (Lampio 1954). The more recent reviews by Lampio (1968, 1969a) describe only the general pattern of moose hunting by residents and hunting by tourists in Finland. These works do not discuss the economic aspects in detail.

Damages caused by the species included in this study are also reviewed. In the case of Alaska, when no accurate compilations are available the amounts presented are only estimates. These figures are also adjusted according to the 4% annual increase from the level of 1964. The Finnish damage compilations are from the archives of the Ministry of Agriculture.

When studying the tables in which the values are summarized, it should be remembered that the Finnish currency was devalued on the 11th of October 1967 by approximately 32%. The exchange rates before and after the devaluation are: $1.00 = Fmk 3.22, $1.00 = Fmk 4.18 (Bank of Finland).

GENERAL POLICIES AND MANAGEMENT ORGANIZATIONS

Alaska

According to the Constitution of the United States, the wildlife resources belong to the people and the management responsibilities to the states. Publicly owned lands are generally open for hunting. In Alaska extensive areas are owned by the federal government; the state of Alaska has control over relatively small areas in south-central Alaska, along the highway system, and on the arctic coast. Privately owned areas are restricted mainly to the vicinity of population centers and do not present any real problem for organized game management. An exception exists in some areas along highways where private land can interfere with access to public land further back.

Game management, administration and research in the state of Alaska are primarily the responsibilities of the Alaska Department of Fish and Game.[1] The state is divided into three regions for administrative purposes. These are the Southeastern, South-central and Interior-Arctic regions. Area biologists are stationed throughout the regions, although the majority are located at a single administrative

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[1]The nearest equivalent in the Finnish administration is a ministry.

center within each region.

The Alaska Department of Fish and Game is led by a commissioner, who usually has the formal education for the position, though he is a political officer appointed by the governor. His deputy and the directors of the divisions are also political appointees, but they are required to have formal education and professional experience in game management. The governor appoints the 10 members of the Board of Fish and Game, which serves as a delegation of the people in close cooperation with the professional staff of the Department. Members of the Board are expected to have a general knowledge of the fish and game resources of the state and are presumed to be selected without regard to political or other special interest. The Board has regulatory power but not administrative or fiscal power. The Board of Fish and Game may also establish advisory committees in designated localities. The members of these committees should be well informed of the local resources and situation. They have the authority to hold public hearings, make recommendations and forward them to the Board for consideration. The commissioner may give authority to the advisory committees for emergency closures during established seasons (State of Alaska 1968).

Sportsmen's organizations do not have a special status in this system. When changes are wanted, as in open seasons or in bag limits, these associations can act as pressure

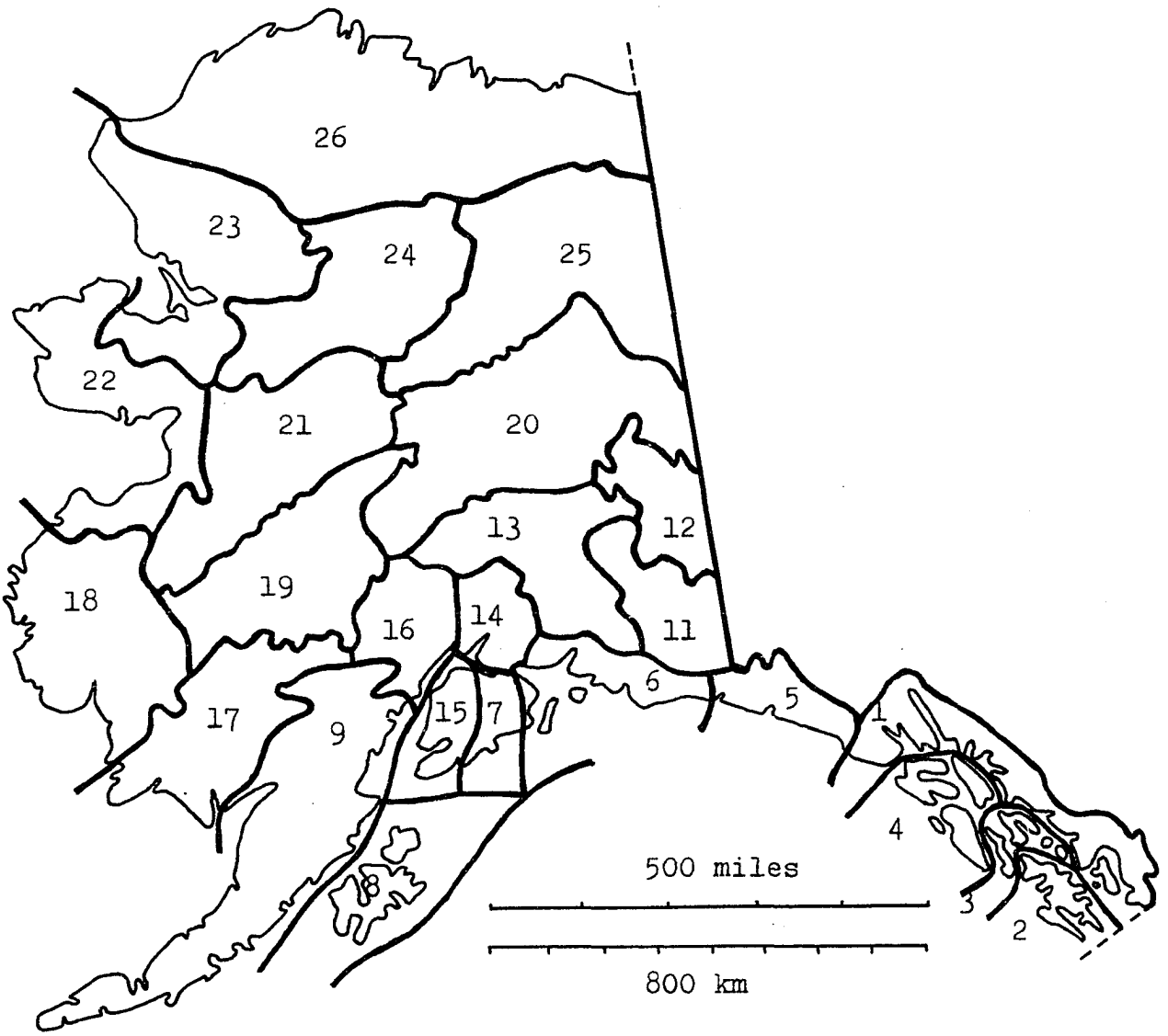

Fig. 2. The Game Management Units in Alaska proper and some adjacent islands (Alaska Department of Fish and Game 1969).

groups. Normally local advisory committees arrange public hearings in which individuals and groups can present their criticisms and make proposals. This type of direct communication is extensively used in Alaska, in considerably larger scale than required by the statutes (Hinman, pers. comm.).

The Alaska Department of Fish and Game cooperates with other resource management agencies and institutions, for example, the U. S. Fish and Wildlife Service (which shares many responsibilities in game management in the state), the U. S. Forest Service, the U. S. Bureau of Land Management, and the University of Alaska. The Department itself is divided into several divisions, of which the Divisions of Game and Protection are of major interest in this study.

Field research, observations and data collection are done mainly by professional personnel. Sportsmen provide some material and information, especially through the harvest ticket system adopted by the Department. Questionnaires sent to selected groups of individuals have been used to some extent (Weeden 1963, 1965b and 1968).

The Department administration also includes an Education and Information section. This section produces informative material such as series of wildlife booklets and leaflets, films and television programs. In the different regions, game biologists cooperate with the local channels of information, including the press, radio and television. Popular articles have also been published in

Alaska Magazine (formerly Alaska Sportsman). The Department of Fish and Game does not regularly publish an information periodical for the general public. Scientific papers resulting from work of the Department biologists appear occasionally in national journals.

The operation of the Alaska Department of Fish and Game is financed by funds derived from the sale of hunting and fishing licenses and big game tags which are required for non-residents. Funds from these sources cannot be used for any other purpose, although the Legislature must approve the appropriation of these funds for each fiscal year.

Another source of funds is through the Federal Aid in Wildlife Restoration Act (Pittman-Robertson Act), which in the fiscal year 1969-1970 included about 75% of the total budget of the Game Division. According to the provisions of the Pittman-Robertson Act, these funds are accumulated by levying a 10% excise tax on the sale of sporting firearms and ammunition. This money is under federal control and is provided to the states on the basis of their size and license sales. Its use is restricted to management, research and land acquisition purposes only. In the fiscal year 1969-1970 the Alaska Department of Fish and Game received about $1.2 million of this federal aid.

State bounties are paid from the general treasury as appropriated by the Legislature.

The organization of the Alaska Department of Fish and

Game is diagramed in Appendix, no. I.

Finland

Wild, free-living animals, according to the Finnish hunting law (290/62), do not belong to anybody. They are res nullius, things without an owner (Kytömaa 1965). The right or privilege to hunt, to stalk and take animals in a certain area using acceptable methods is associated with the land ownership. In some areas, especially in the northern part of Finland, local people have the right to hunt in areas owned by the state unless there is a special prohibition. This right is restricted within each political subdivision, or commune, to permanent residents. On uninhabited islands which belong to the state and are situated in the outer archipelago outside the communal boundaries, every Finnish citizen has the right to hunt. State officials may also restrict this right if necessary, for instance when seabird refuges or military reservations are established.

If the land areas owned by the state and controlled by the State Forestry Board[2] are considered as public domain and as distinct from areas owned by industrial companies, communes, parishes and private citizens, most of the potential hunting grounds in Finland are privately owned. In

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[2]Approximately equivalent to the U. S. Forest Service.

southern Finland state forests are in small units and their total area is very limited. In the northern part of the country, beginning from the watershed region of Ostrobothnia, the amount of state forests increases (Fig. 3). As mentioned earlier hunters residing in the north may obtain the right to hunt on the state lands inside their communes, but in the south the only practical method for hunters is to establish a hunting club or unofficial sportsmen's circle with the active cooperation of landowners, and to lease additional areas if necessary.

The Finnish game management organization is completely non-political and is based on the intensive cooperation of the hunters. At the government level, the Bureau of Fisheries and Game is in the Ministry of Agriculture and has mainly administrative and supervisory duties. The State Game Research Institute is the center for game biological research and experimentation. Various departments of universities and state research institutes also carry out some additional game research.

The field organization of game management, the Central Organization of Hunters, is responsible for general information, education and the practical work of management. The country is divided into 14 game management districts (Fig. 4), each of which has a full-time district supervisor. Åland, an autonomous province, has its own and somewhat different regulations and is excluded here. The smallest

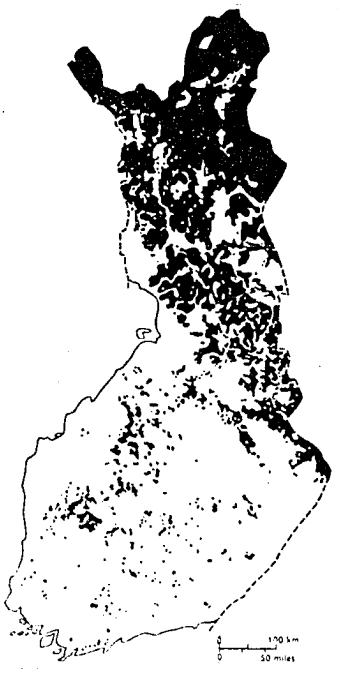

Fig. 3. The distribution of State Forests in Finland (Metsähallitus 1959, from Sømme 1960).

Ownership of forests in Finland
(Sømme 1960)

	Area	Growing stock	Annual growth
	%	%	%
Private	60.3	63.2	72.2
State	30.8	25.5	16.3
Companies	7.0	8.9	8.9
Others	1.9	2.4	2.6

Total area 21,874,000 hectares

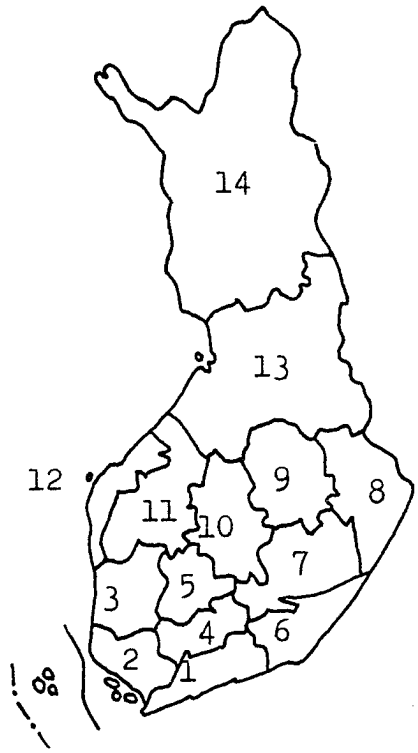

Fig. 4. The Game Management Districts of Finland

1 Uusimaa

2 Vars.-Suomi

3 Satakunta

4 E-Häme " (South Häme)

5 P-Häme " (North Häme)

6 Kymi

7 E-Savo (South Savo)

8 P-Karjala (North Karelia)

9 P-Savo (North Savo)

10 K-Suomi (Central Finland)

11 Pohjanmaa (Ostrobothnia)

12 R-Pohjanmaa (Swedish Ostrobothnia)

13 Oulu

14 Lappi (Lapland)

unit in this organization is a game management association. The number of these associations was 300 in 1968 (Central Organization of Hunters 1968). The boundaries usually correspond to the communal boundaries. Every person who has purchased his hunting license is a member of the association of the place of purchase if he does not specify an alternative. Hunting clubs and similar groups do not have a special status but are represented by their members through the associations.

Seasons are determined and regulations, including various regional exceptions, are published by the Ministry of Agriculture after the recommendation from the Central Organization of Hunters. Local associations may restrict these seasons, set individual bag limits, or restrict the methods of harvesting on an annual basis. They can and do send their proposals forward through official channels.

Law enforcement is mainly in the hands of voluntary wardens elected from among the members of game management associations and hunting clubs. Wardens are sworn in by a court, and they have the same power as regular police officers when on duty. Provincial police detachments also have a few officers who cooperate with the voluntary wardens. Officers of rural police, Border Guards, Coast Guards and personnel of forest management organizations share the responsibilities of law enforcement.

In function the Finnish game management organization

is very democratic. In the general annual meeting of a game management association, hunters elect the members of the local board of trustees. The associations are represented on the boards of the districts, and the districts themselves are represented in the various organs at the national level. The State Game Research Institute and the State Forestry Board are also represented on the National Board of Trustees. The State Supervisor for Conservation and the director of the Bureau of Fisheries and Game are ex officio members. All representatives are elected and the ex officio members are professionals of various fields. There are no political appointees in the whole organization.

The professional staff involved in research and administration is small. The educational background of the district supervisors varies considerably. The State Game Research Institute obtains a major portion of material and information needed through a special network of voluntary assistants and observers. This consists of some 600 individuals or groups in the interior of Finland and some 100 individuals or groups in the coastal areas (State Game Research Institute 1968). The annual route-counts of tetraonid birds in 1968 involved some 2,700 persons who counted on 608 routes giving a total length of 22,530 km. Moose counts require the cooperation of several thousand men. Recently, when the Värriö Subarctic Research Station in northeastern Lapland became operational, the Department of

Agriculture and Forest Zoology of the University of Helsinki, which controls the station, organized a local network of observers. In 1969 this network included more than 1,000 individuals (Pulliainen, pers. comm.).

The cooperation of hunters with research personnel also requires that the results of investigations are made available to the hunters. This is done by the Central Organization of Hunters in the information magazine Metsästäjä - Jägaren (The Hunter). The magazine, which has six issues a year, is delivered without additional cost to every person who has purchased a hunting license. The circulation of the Finnish edition in 1969 was 180,000, and that of the Swedish edition 11,000. The spring issue (March-April) has since 1968 been a special game management guide. Suomen Riista (Finnish Game), the journal of the Finnish Game Foundation (see Linnamies 1962, 1968), is delivered free to the voluntary assistants of the State Game Research Institute. This journal, published in volume format, presents scientific papers in semipopular style and serves as an important channel of information between research personnel and hunters (see Nyberg 1968a). Scientific papers are also published in English in another journal of the Finnish Game Foundation, Riistatieteellisiä Julkaisuja - Papers on Game Research.

In addition to a major portion of data collection, almost all work in practical management is done voluntarily

by sportsmen. This includes habitat manipulations, artificial feeding in winter, establishing game fields and other similar activities. Some larger industrial companies, which manage certain areas for hunting as a part of their public relations program, may assign these duties to some of their employees. Generally speaking, hunting clubs and other local groups of hunters do most of the practical management work. Financing is needed for materials and equipment, and therefore approximately 50% of the annual budget of the Central Organization of Hunters is appropriated to the game management districts and associations. Farmers usually cooperate by providing left-over grain, seeds for game fields and construction material directly from their forests. A partial summary of these activities in 1967-1968 in presented in Table 1.

The Finnish game management organization is financed mainly with funds derived from license fees. In 1968, based on the license fee of Fmk 14.00 ($3.35), this amount was Fmk 2,358,000 ($564,100). According to Rajanto (1969), this was used as follows: (1) administration, wages and research expenses about 47% and (2) information magazine and other educational activities, liability insurance[3] and appropriations to the game management districts and associations, about 53%, which is used to cover the expenses of

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[3]The fee is included in the price of the hunting license.

Table 1. A partial summary of the activities of the Finnish game management associations, March 1967-February 1968 (The Central Organization of Hunters 1968).

Districts and no. of associations in each	Used in winter feeding, kg			No. of feeding places		Habitat improv., no. of places*	Sporting contests
	Grain	Forage cabbage	Hay and other	Game fields	Other		
1 Uusimaa, 31	100,945	36,200	38,625	383	2,533	699	42
2 Vars.-Suomi, 18	18,050	23,880	9,370	115	709	405	29
3 Satakunta, 21	14,700	13,300	18,840	160	1,360	593	50
4 E-Häme, 16	24,990	33,600	17,000	77	2,324	448	54
5 P-Häme, 15	3,230	8,740	10,060	132	1,052	484	20
6 Kymi, 20	4,020	19,545	11,970	161	3,220	1,468	25
7 E-Savo, 25	940	6,530	4,975	242	1,763	364	42
8 P-Karjala, 15	565	510	5,945	99	1,124	264	38
9 P-Savo, 25	2,475	1,295	6,090	162	1,721	1,232	12
10 K-Suomi, 21	1,835	3,705	5,465	183	876	753	34
11 Pohjanmaa, 34	26,090	5,035	18,265	134	1,199	1,653	29
12 R-Pohjanmaa, 8	3,040	2,730	5,540	76	1,347	266	11
13 Oulu, 33	3,240	1,810	8,130	121	1,138	1,986	38
14 Lappi, 18	400	170	2,040	5	382	31	10
Total: 300 assoc.	205,120	157,050	162,315	2,050	20,748	10,656	434

* Includes planting of food and cover plants, cutting of willows and disinfecting feeding places with lime (CaO).

management work. Some additional appropriations are made by the government from funds collected as moose permit fees. Part of these funds are used in compensating moose damages (e.g., 36.3% of the total funds in 1968), but the rest is used by the government for other purposes and not necessarily for game management or research.

The diagram of Finnish game management organization is included in Appendix, no. II.

MANAGEMENT PRACTICES

The Moose, Alces alces

Alaska

Alaskan moose belong to the race Alces alces gigas, which is considerably larger than its Fennoscandian counterpart, and Alces a. andersoni, which has limited southeastern distribution (Manville and Young 1965, Klein 1965). The early history of moose in Alaska has been excellently reviewed by Lutz (1960). According to Lutz (op. cit) moose have been present in Alaska for a long time, but apparently for reasons which seem to be quite complicated they have recently (after the 1870's) become more numerous in some areas where they were not common earlier. This created a general tradition that moose are comparatively late arrivals in these regions and to some extent in Alaska as a whole. This is, however, the situation in parts of southeastern Alaska into which moose penetrated only some four or five decades ago (Klein 1965).

The Alaskan moose populations are presently estimated at 120,000 animals (Courtright 1965). One of the characteristics which is of major importance is that there are several separate populations, e.g., in the Matanuska Valley (Rausch 1965a), Yakutat (Rausch 1965b), the Susitna Valley (Rausch 1958), and in the Kenai Peninsula where two major

herds may actually be distinguished (Bureau of Sport Fisheries and Wildlife 1968). Also in the large Interior, where the basins of the big rivers such as the Yukon provide good moose habitat (Chatelain 1954), mountain ranges divide moose populations into local subpopulations.

In the periphery of their distribution moose have been observed to be increasing. This has happened naturally on the Seward Peninsula and in the arctic areas, where moose occur along major rivers such as the Colville (Chatelain 1954). In southeastern Alaska natural penetration through the Coastal Range has led to the establishment of local populations (Klein 1965). Man has also assisted their distribution here by several transplantations (e.g., Courtright 1965). The range of occurrence of moose in Alaska is presented in Fig. 5.

Management of moose in Alaska is mainly based on control of the harvest. Harvest tickets which are required for all moose hunters were introduced in 1963 (Rausch et al. 1966). Returns have been quite high, 93-95%, and the majority of those who do not report either did not hunt moose at all or were unsuccessful (Rausch 1965a). The estimated annual kill increased from 4,000 animals in 1958 to 9,000 in 1962. The best statewide success was achieved in 1964 when 21,135 hunters bagged 8,770 animals, success equalled 41.5% (Courtright 1968). Harvest tickets are issued without a fee, and a considerable portion, 20-30%,

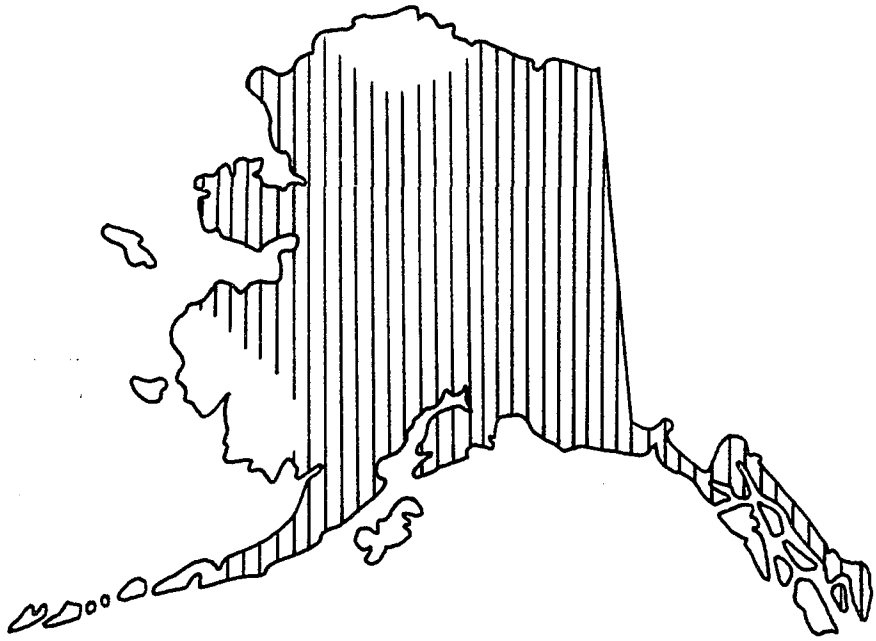

Fig. 5. Distribution of the moose, Alces alces, in Alaska (Manville and Young 1965).

of those who obtain tickets do not hunt moose. Hunting itself is usually done individually or in small parties of two or three men (Courtright 1965).

When moose management is arranged on a regional basis, open seasons and bag limits are variable and detailed information is issued annually by game authorities. Seasons may be continuous for both sexes throughout the whole hunting period, or there may be separate seasons for bulls and for "antlerless moose." Because of the differences in seasons from year to year, comparisons of the composition of annual harvest are not very meaningful. Generally, however, calves are harvested only lightly except in a few areas like the Matanuska Valley, where the local population is managed primarily for maximum production. Here, as on the Kenai Peninsula, males have been much reduced. The major reasons for the restrictions in harvesting of "antlerless moose" are public sentiment and lack of knowledge of the structure of the populations (Courtright 1968). On the Kenai Peninsula antlerless moose have been lightly utilized, and local shortages of males have been observed. The range of fetus sizes suggests that some females are not bred until their second ovulation and observations also indicate that a fairly large portion of animals examined may not have been bred (Rausch 1965a). On the other hand, the Matanuska Valley herd has shown good productivity although male moose also have been reduced (Rausch 1965a, Table 1).

In general, Alaskan moose are underharvested because of limited access into large areas in the Interior. Hunters seem to seek areas which have received the most favorable publicity, where access is available and where the moose can be seen easily. Only in a few areas like the Matanuska Valley does the annual harvest remove the "interest" or annual production, in this case some 25% of the population (Rausch 1965a).

The role of accessibility is of major importance in the management of moose in Alaska. Courtright (1968) states that it is possible to increase the absolute annual harvest by 50% with mainly beneficial results for the population. This means the annual take of some 15,000 from the estimated population of 120,000 animals, and still this is apparently far below the maximum level that would allow a sustained yield. Regional regulations are one method to direct more hunting pressure to the areas where populations are underharvested. The construction of air-strips and trails as a direct method in providing better access has been suggested and also carried out (Courtright 1965, Klein, pers. comm.). As the first step toward better utilization of these remote populations information concerning the methods of transportation used by hunters has been collected during recent years (Bishop 1969).

Habitat requirements of the moose, as well as population structure and dynamics, have been studied intensively

especially during recent years. Palmer (1944) gives the date of the beginning of moose studies in Alaska as 1920. Under the research program of the Alaska Department of Fish and Game large-scale studies have been carried out to detect the special characteristics of various moose populations (see, e.g., Rausch 1965a). These studies are aimed toward establishing criteria for proper management of these local herds. Many moose populations in Alaska migrate to lower elevations during early winter, and concentration of moose in limited areas of winter range may cause serious overuse of vegetation if suitable food species are not abundant. Range inventories, executed either by aerial photography or by exclosure studies on the ground, provide information about the food which is available and also how many moose a particular area may support during normal and critical conditions. These studies, however, have been very limited in extent (Bishop 1969, Klein, pers. comm.).

Sex and age composition studies are based on extensive aerial counts and the strip- and one sq. mile-quadrat censuses are methods that have been employed. As reported by Evans et al. (1966) the latter seems to be more efficient. Flying time is almost the same, but fewer animals are missed than in the strip-census (also Bureau of Sport Fisheries and Wildlife 1964).

Collection of samples, jaws and reproductive organs, are made by professional biologists and to some extent by

voluntary cooperation of sportsmen. Highway and railroad kills along with other miscellaneous moose kills provide specimens for scientific use.

Seasonal migration, which is an important characteristic of various herds, is studied by tagging moose and then collecting observations and records of killed individuals. The same method also provides information about the general life-history of the animals (e.g., Rausch 1965b).

Moose-environmental relationships are being studied on the Kenai National Moose Range on the Kenai Peninsula. This area of 6,900 km^2 (2,700 sq. miles) of excellent wildlife habitat is designated primarily for the preservation of the large Kenai moose. The history of the moose on the Kenai Peninsula has been reviewed by Lutz (1960), as mentioned earlier. Some 8,500 moose live in this area today. The buildup of this considerable population was possible when extensive forest fires burned large areas of timberland, which were then replaced by successional stands of hardwoods--aspen, birch and various willow-species--all important browse plants for moose. The last large-scale burn in 1947 spread over 118,400 hectares (290,000 acres), and in 1965 this area was producing the major portion of moose browse on the range (Bureau of Sport Fisheries and Wildlife 1966). In the summer of 1969 the Swanson River fire burned nearly 36,000 hectares (90,000 acres).

The Kenai National Moose Range provides a large experi-

mental area for basic research on habitat requirements and range-production relationships of moose. There are four 1 sq. mile enclosures each stocked with a known number of moose. The soil and vegetation were carefully analyzed before stocking took place. Changes in the moose population and the condition of range inside the enclosures are planned to be observed and studied over an extended period of time. These studies have been conducted in the area since January 1968 by Alaska Department of Fish and Game biologists and staff of the Moose Range, which is under the administration of the federal Bureau of Sport Fisheries and Wildlife, U. S. Fish and Wildlife Service (see Rausch and Bishop 1968).

The Kenai National Moose Range is also the only area where such a method as habitat improvement has been used. Because the Kenai moose herds migrate to some extent the wintering areas are under heavy use. Overbrowsing has been observed in some areas, and when snow conditions were extremely severe, die-offs of moose because of malnutrition were reported (Bureau of Sport Fisheries and Wildlife 1962). If general supression of wild fires is successful, habitat improvement may be necessary to meet the demand for large quantities of moose browse at least in the areas in which they tend to concentrate during winters.

The methods used in habitat improvement are commercial harvesting of timber, controlled burning to a limited extent, but above all the clearing of non-commercial spruce stands

by mechanical equipment. The most efficient and inexpensive equipment has proven to be a roller-chopper, a large heavy cylinder fitted with blades and pulled by a caterpillar tractor. The blades of the roller cut and break woody vegetation. The pole size spruce are usually killed by this treatment while the hardwoods recover rapidly from seedlings and root sprouts. This range rehabilitation work had covered 2,650 hectares (6,500 acres) by 1967. This work has been restricted to the areas of the 1926 and 1947 burns. Some experimental plantings of willow cuttings and birch and cottonwood, Populus balsamifera, seedlings have also been carried out. The success has varied, and in 1964 six of 81,000 planted willow cuttings were alive, but the experiments of 1964-1965 resulted in the survival of 30% of the willow cuttings and 54% of the cottonwood seedlings (Bureau of Sport Fisheries and Wildlife 1961, 1964, 1965 and 1967).

Winter feeding is not generally practiced in Alaska even in the areas of critical winter concentration of moose. This method is by no means unknown, but is reported as an emergency practice as early as 1923 (Culver 1923, Walker 1923).

Finland

The moose in Finland has survived some critical periods. Towards the end of the nineteenth century the population, decimated by predators, diseases and uncon-

trolled hunting, began to increase, and the first license-based season was allowed in 1906. Before World War I the moose population was quite high throughout the whole country. The following years, however, were not favorable for further increase. During the war-years poaching was the major decimating factor. Thus, in 1923 moose were placed under full protection for an indefinite period. After ten years, when populations were observed to be recovering rapidly, hunting was allowed again (Linnamies 1959, Mäki, pers. comm.). According to Sainio (1956b) the population was estimated in the winter of 1934-1935 to be some 2,900-3,400 animals. Rapid increase occurred during the 1950's, and the results of two nationwide moose-counts in 1962 and 1966 showed the moose population to be some 30,000 and 40,000 animals respectively (Koivisto 1962, 1966). Lapland was excluded in the latter count, and the population of this province was only estimated on the basis of the 1962 count. The rapid increase slowed considerably in 1960 and some decrease was observed locally (Koivisto 1962, 1963). Koivisto (1963) suggests that the increased harvest might have been one reason. A downward trend has also recently been observed in the moose populations in Norway and Sweden (Lampio 1969b). The current distribution of moose in Finland is presented in Fig. 6.

Finnish moose studies have been directed mainly toward two problems: population studies to give a sound basis for

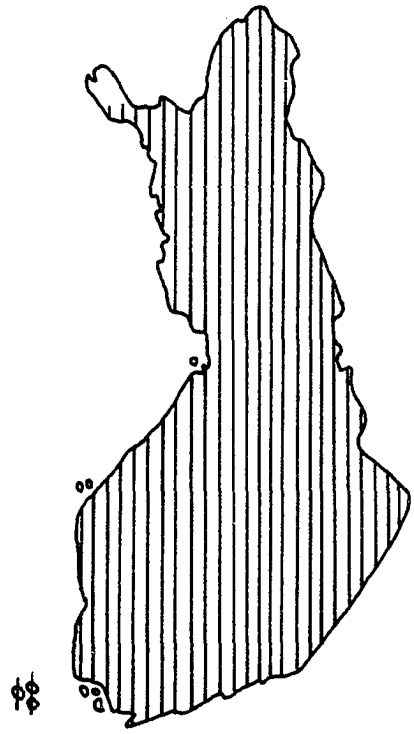

Fig. 6. Distribution of the moose, Alces alces, in Finland (Helminen 1969).

harvesting moose and studies on foods and feeding of moose with special reference to moose damages from the silvicultural point of view.

Because forestry has for a long time been the major industry of Finland, foresters have for a long time focused attention on moose damages in pine plantations (Ehrström 1888, Hallgren 1892; cited from Kangas 1949). Survival of damaged young trees and subsequent insect attacks and fungus infections were studied by Kangas (1949). Sainio (1958) and Yli-Vakkuri (1956) discuss the principles involved in avoiding moose damages by sound and inexpensive silvicultural practices. Koskimies (1953) and Sainio (1956a) studied winter foods of moose, and recently Pulliainen, Loisa and Pohjalainen (1968) described the special food problems of moose in Lapland.

Population studies of Finnish moose have mostly been carried out by Koivisto (1962, 1963, 1966). The nationwide counts took place in 1962 and 1966, but some preliminary counts were made earlier by local game management associations and hunting clubs by skiing around their hunting grounds and searching all probable moose habitats. In state owned lands the State Forestry Board was in charge. Counting from aircraft was also tried experimentally in 1966 by some game management associations around the city of Pori (western Finland). The results were encouraging (Koivisto 1966).

In ground counts skiers make notes of the animals seen and also their tracks. The proportions of calves and adults are estimated on the basis of these observations. Special notes are made on the working maps when moose go across the borderline between adjacent counting plots. These are considered when an area summary is given to the local association for compilation.

During recent years some preliminary studies on migrations of moose have been done in northeastern Lapland (Pulliainen and Loisa, in press). These studies will be continued as a part of a larger game research project in this particular area.

The basis of moose management in Finland lies in the controlled harvest, which is annually arranged according to the most recent information from the field. Licenses are issued separately for adult moose and for calves. According to Koivisto (1963) overharvesting has evidently occurred in some areas. The proportion of calves in the population, 20-30%, showed that the production had been good, and the population increased some 20% during the period 1962-1966. However, the increase was slower than during the 1950's. Koivisto (1963) suggested that the hunting of cows without calves should be done with more caution. This portion of the population has been heavily harvested because it is illegal to take a cow accompanied by a calf or both of them. Also bulls of prime condition should be saved, although

younger bulls may be taken to a larger extent in favor of cows in general. The harvest of calves should be greater than the nationwide average, which has been about 10%. In the game management district of Uusimaa, which is one of the most productive moose regions, about 20% of animals taken annually have been calves. In this district a serious effort has been made to increase the number of calf permits to 25-30% of all permits approved (Lahti 1966). By increasing the average age of the population there will be also an increase in productivity (Koivisto 1963, also Henrikson 1967).

The reporting of hunting results is mandatory, even when the hunt has not been successful. Failure to report will cause the rejection of the subsequent application for a permit by a person or hunting party in question. The report form is also a questionnaire, and it yields information on the sex and age distribution in the population. Lower jaws of both sexes and reproductive organs of females are also collected on a voluntary basis. In 1964, for instance, the number of samples was 969 (Rajakoski and Koivisto 1966). The collection is continuing (State Game Research Institute 1968).

In 1960, 1961 and 1962 special questionnaires were sent by the State Game Research Institute to all persons and groups receiving moose permits for the coming season. By this method information concerning moose seen during the

open season was collected. The inquiry yielded some 60,000 observations. From this data conclusions on the population composition and productivity were drawn. This information was later compared with the results of the first nationwide count (Koivisto 1962).

Among other management practices habitat improvement is the most common (e.g., Vartiainen 1964). It is easily done in conjunction with silvicultural practices, logging and reforestation, as well as with winter feeding where the latter is needed. Moose prefer young forests (less than 40 years of age) where hardwood species are abundant. Leaves of deciduous trees and various grasses form the bulk of summer food. In winter, willows, aspen, Populus tremula, and pine, Pinus silvestris, are the important browse plants. According to Sainio (1956a, c) the winter diet of moose is composed of willows, 70%; other deciduous trees, 20%; and pine, 10%. Among the willows, Salix caprea, S. aurita and S. cinerea seem to be preferred (Seiskari 1956). In north-eastern Lapland, because of the scarcity of willows, pine is the most important winter food for moose (Pulliainen, Loisa and Pohjalainen 1968).

Habitat improvement thus requires saving the preferred browse plants, especially in the areas which are of secondary importance for intensive silviculture (Seiskari 1958, "Saisa" 1963, Valleala 1954). Clearings made for high voltage power-lines are very suitable for this purpose. In

all clearings, however, regular cutting is required so that the woody species do not grow out of reach of moose (Suomus 1958). Habitat improvements which are made with moose in mind are also beneficial for the snow hare, Lepus timidus, and the willow ptarmigan, Lagopus lagopus, because the growth of food and cover plants is increased. Artificial salt licks and "salted aspens" (Vartiainen 1964) have proved to be useful in keeping moose in certain areas and especially in keeping them away from pine plantations. Aspens are salted before planned cutting. In spring, holes of 1-1½" in diameter are bored in the trunks of standing trees. Holes are filled with salt and closed with wooden plugs. In August the salt is well distributed in twigs, bark and leaves. According to the observations cutting may be started at that time, and moose will eagerly use these aspens starting with leaves and bark.

If aspen is abundant, felling them for winter food of moose and hares is a very common practice. Moose do not actually require winter feeding in Finland, and this practice is generally done to encourage the establishment of local herds.

Habitat improvement in some areas may require introduction of preferred browse and forage plants. Willows are easily introduced in suitable places like power-line clearings and moist depressions in the forest. These practices may sometimes be quite successful (Könönen, 1966, 1968).

In areas where natural browse plants are not abundant or are out of reach of moose, "game fields" may partially solve the problem of keeping moose in these areas over the winter. Game fields can be established on abandoned agricultural lands, small clearings in the forest, on the edges of drained peat-bogs or other similar places. Fields are normally prepared and some agricultural crops are sown. Oats, Avena sativa, thrive quite well even on nutrient-poor soils. Crops may be collected normally and stored for winter or left standing for direct utilization by game animals (Lahti 1968, Suomus and Mäki 1968).

Management of moose by habitat improvement is now recognized among sportsmen. This is the only sound and quite inexpensive method in preventing moose in many areas from being transient animals, and to establish small sedentary herds to ensure annual hunting.

The Muskrat, Ondatra zibethicus

Alaska

Most of the Alaskan muskrats belong to the race spatulatus, which occupies the Interior south of the Brooks Range and is found in a few localities in southeastern Alaska. Another race, zalophalus, occurs on the Alaska Peninsula (Manville and Young 1965). Hall and Cockrum

(1953) draw the border between these races farther north to include muskrats south of the Alaska Range in the race zalophalus (Fig. 7).

According to the Alaska Department of Fish and Game (Burris, pers. comm.), the muskrat has received very little attention as far as basic research is concerned. Elkins (1951) proposed life history studies as the normal first step in basic research. He also pointed out the possibilities to use information obtained from outside Alaska. From 1950 to 1953 the Alaska Cooperative Wildlife Research Unit carried out a quite large preliminary study in the most productive muskrat areas in the Territory of Alaska (Buckley 1953). Of these areas the Yukon Flats, the Yukon-Kuskokwim delta and the area around Selawik and Kobuk are still the major source of annual harvests (Burris 1969). The investigations showed that hunting and trapping pressure is not evenly distributed and that only a small part of good muskrat habitat is utilized. This is due to the method of transportation, which during the breakup is almost entirely by a canoe or boat. Muskrats from areas which are left underharvested rapidly repopulate depleted areas. Buckley (1953) mentions also that the effects of hunting and trapping upon the muskrat population in general are light. According to the Alaska Department of Fish and Game, this statement is still valid (Burris, pers. comm.).

The nearest field survey pertinent to the Alaskan musk-

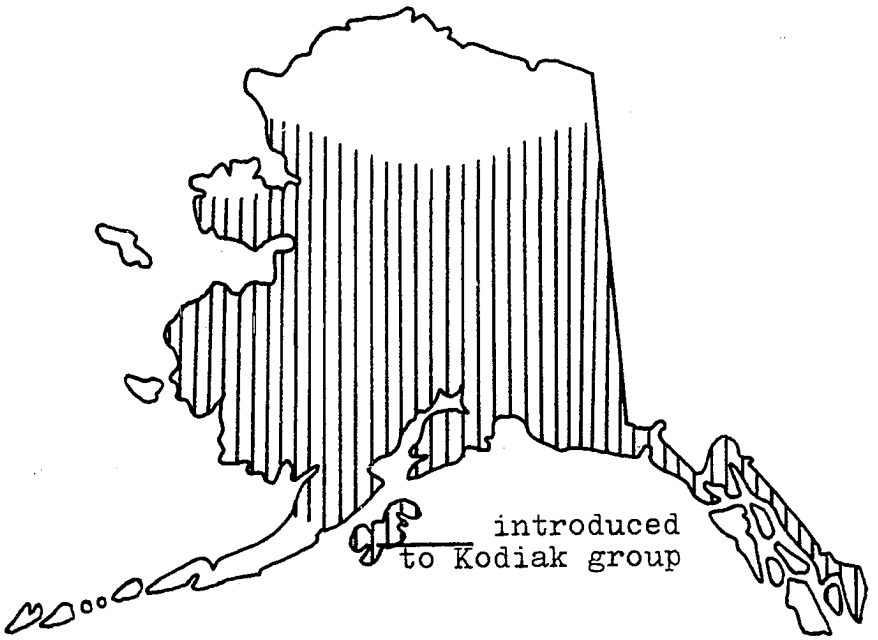

Fig. 7. Distribution of the muskrat, Ondatra zibethicus, in Alaska (Manville and Young 1965).

rat was done by Cowan (1948) in the Mackenzie Delta in the Canadian Northwest Territories. The management proposals presented by Cowan (op. cit.) are: controlled trapping by applying registered traplines, which was also recommended by Elkins (1951), and improvements in techniques, most of all by eliminating shooting which decreases the value of the pelts. Scott (1951) mentions that 35% of Alaskan muskrat pelts are damaged by improper handling. Cowan (op. cit.) states that the prices for pelts damaged by shooting are 25% lower than those trapped during winter. In Alaska, however, trapping in mid-winter is often not feasible due to thick ice, and shooting during the spring breakup may be the most practical method of harvest in spite of the decreased value of pelts associated with this method of harvest.

The environmental factors listed by Cowan (op. cit.) for the Mackenzie Delta are the same as those which are either beneficial or detrimental for the well-being of the muskrat elsewhere (e.g., Errington 1948, Artimo 1960).

The muskrat was introduced to Kodiak Island in 1929 and later to Afognak and Raspberry islands in the same group. It has also been transplanted to the Pribilofs and Prince of Wales Island (Palmer 1938, Manville and Young 1965). Along with the established long trapping season, from early winter to spring, these introductions are the only major programs carried out in the management of the muskrat in Alaska.

Presently there are no bag limits set for muskrats in any of the game management units (Alaska Department of Fish and Game 1969).

Finland

Muskrats were introduced into Finland in the early 1920's. Approximately 800 specimens of the nominate race, Ondatra z. zibethicus, were imported, some 700 of them from Ontario, Canada, and some 100 from Czechoslovakia (originally from Ohio). In addition, less than 300 specimens of the Virginian muskrat, Ondatra z. macrodon, were released, some of which were reared on Finnish fur-farms (Artimo 1960). In 30 years the muskrat spread over the country (Artimo, op. cit., Fig. 16). Only oligotrophic waters of Lapland proved to be unsuitable for them (see Järnefelt 1925). The survival of the Virginian race was poor, and in most cases it disappeared or mixed with the brown populations. In 1953 only a few local populations of the race macrodon existed, the largest of them around Lake Saimaa in southeastern Finland (Artimo, op. cit., Fig. 21).

In the late 1950's and early 1960's the muskrat was observed also in the outer archipelago, in Lågskär, Åland, and in the island group of Valassaaret in the Gulf of Bothnia (Hilden and Sten 1964). The current distribution is shown in Fig. 8.

Immediately after the introduction, public discussion

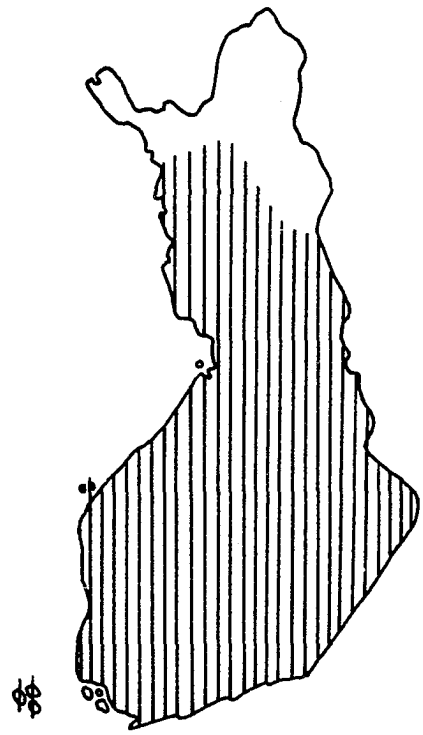

Fig. 8. Distribution of the muskrat, Ondatra zibethicus, in Finland (Helminen 1969, Hilden and Sten 1964).

began on the possible effects of this new species upon waterfowl and fish. The first inquiry by the Ministry of Agriculture in 1934 to investigate the damages caused by muskrats, however, demonstrated the value of the muskrat as a furbearer, and damages were generally considered to be of minor importance (Klemola 1937).

Artimo (1948, 1952, 1957, 1960) has carried out exhaustive studies on the muskrat in Finland. Brander (1951) published in Swedish a review on the management of the muskrat. These works give very detailed information on habitat requirements, food preference, population characteristics and proper harvesting practices.

Among the methods for the management of the muskrat given by Artimo (1952) the following practices are easily applicable: prevention of cattle grazing on marshy shores, water level control, protection of winter dens against foxes and dogs by using repellents and trapping only during the period when the pelt is prime. Among preferred food plants Artimo (1957) mentions species of Carex, Equisetum, Scirpus, Phragmites, Sparganium, Typha, Nuphar and Potamogeton. These are quite common in shallow lakes and on the shores, and if populations are kept at proper level the amount of food available in nature is adequate. Mussels (Anodonta spp, Unio spp) and crayfish, Astacus fluviatilis, form the bulk of animal food. Although the muskrat eagerly eats crayfish, the damages may be overestimated.

In general, management of the muskrat receives only minor attention. The species no longer has the role as a furbearer that it had some 10 or 15 years ago. It is, however, considered by the Central Organization of Hunters as an important resource in meeting the increasing needs of recreational trapping (Anon. 1966).

The Hare, Lepus americanus, Lepus othus, Lepus timidus and Lepus europaeus

Alaska

Two species of hare are native to Alaska. The tundra hare, Lepus othus, has a very spotty distribution from the Alaska Peninsula to the arctic coastal plain. The taxonomy of this species is not clear, and the tundra hare may be the same species as the arctic hare, Lepus arcticus (Manville and Young 1965). Hall and Kelson (1959) suggest that Lepus othus and the Eurasian snow hare, Lepus timidus, are the same species, and that there may be an integration between Lepus othus and Lepus arcticus andersoni in northern Alaska and Canada.

The other hare in Alaska is the varying or snowshoe hare, Lepus americanus. Its two races, dalli and macfarlani, occupy almost all of Alaska except the areas north of the

Brooks Range, the Seward Peninsula and a large region in the Kuskokwim Delta (Manville and Young 1965). In the areas around Norton Sound its range overlaps with that of the tundra hare (Fig. 9).

The earliest research done on varying hare in Alaska has been parasitological and in connection with the occurrence of tularemia in Alaska (Philip 1938, Philip and Parker 1938). These studies were repeated later in order to observe the possible extension of range of the rabbit tick (Haemaphysalis leporis palustris) and tularemia (Philip, Gill and Geary 1954).

In 1955, the Alaska Cooperative Wildlife Research Unit started a long-term study on the population ecology and fluctuations of the snowshoe hare in Alaska. Home range, population density, habitats and climatic relationships, as well as behavior and food habits, are described in the two major works now completed (O'Farrell 1960, Trapp 1962).

The hare's characteristic 10-year cycle tends to limit rapid progress of these studies, and also explains why there has been a delay in the reactivation of the program. The previous studies, starting in 1959, were carried out in the vicinity of Fairbanks in an 160-acre area of typical interior-Alaskan forest habitat.

Recently, information has been collected about the population fluctuations of upland game, including hare,

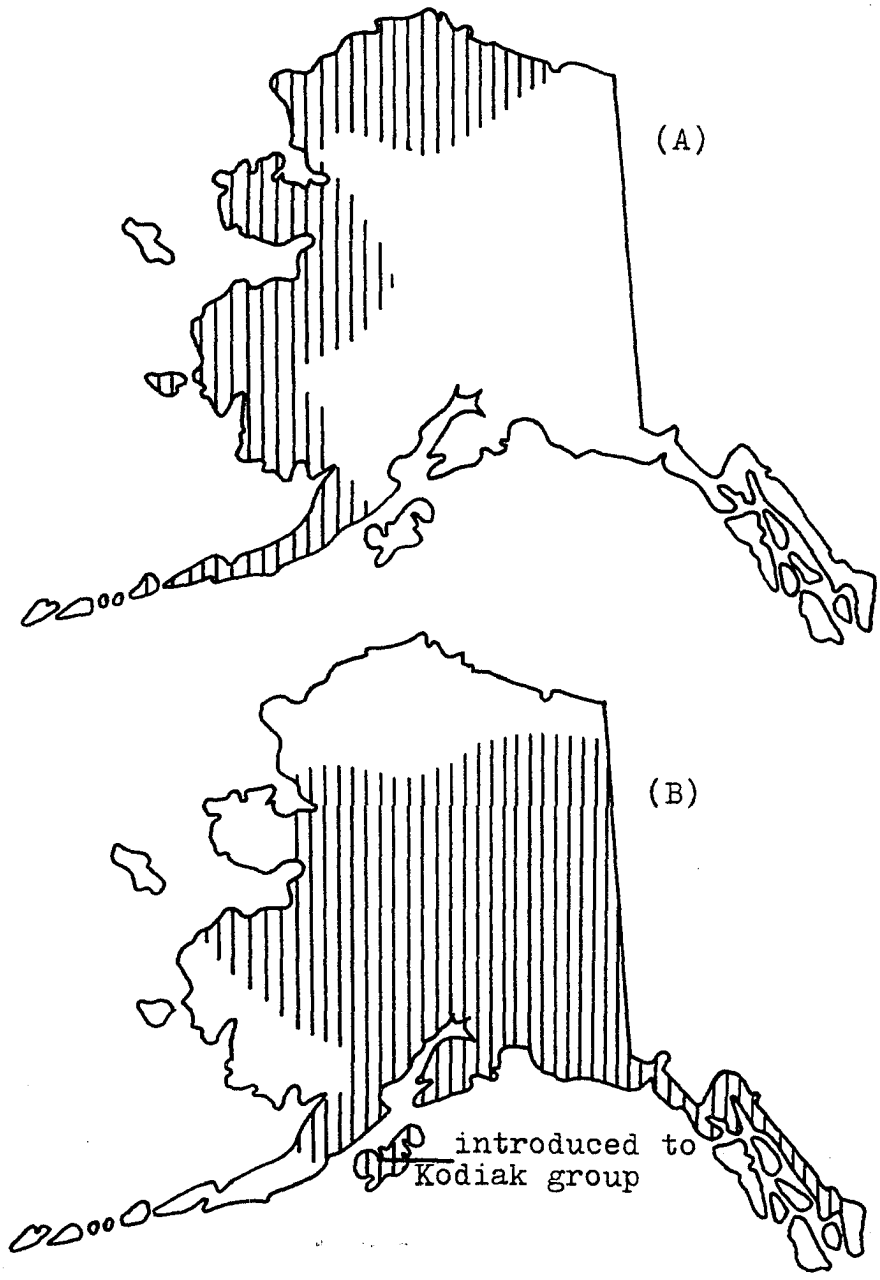

Fig. 9. Distribution of the tundra (arctic) hare, Lepus othus, (A), and the snowshoe (varying) hare, Lepus americanus, (B), in Alaska (Manville and Young 1965).

by questionnaires sent to a limited number of people such as trappers and others likely to have knowledge of the status of small game populations (McGowan and Weeden 1969).

The extent of management of hares in Alaska has been very limited. In 1935-1936 the snowshoe hare was introduced into Kodiak and a few adjacent islands (Manville and Young 1965). In 1960-1961 the original introductions in Kodiak were enlarged and four additional islands were included (Hensel 1961). The Kodiak introductions have proved to be successful.

Open season from September to April, inclusive of both months, as well as a bag limit of five hares a day are currently set for Region I, southeastern Alaska. Elsewhere in the state there is no closed season and no bag limit (Alaska Department of Fish and Game 1969).

Finland

Finland has two native species of hare, the snow hare, Lepus timidus, and the European hare, Lepus europaeus, of which the former is more common and distributed over the whole country. The European hare has a southwestern distribution with an extension northward along the Gulf of Bothnia (Fig. 10).

Management of both hare species in Finland is based on habitat improvement, species-specific winter feeding and, most importantly, locally controlled harvesting.

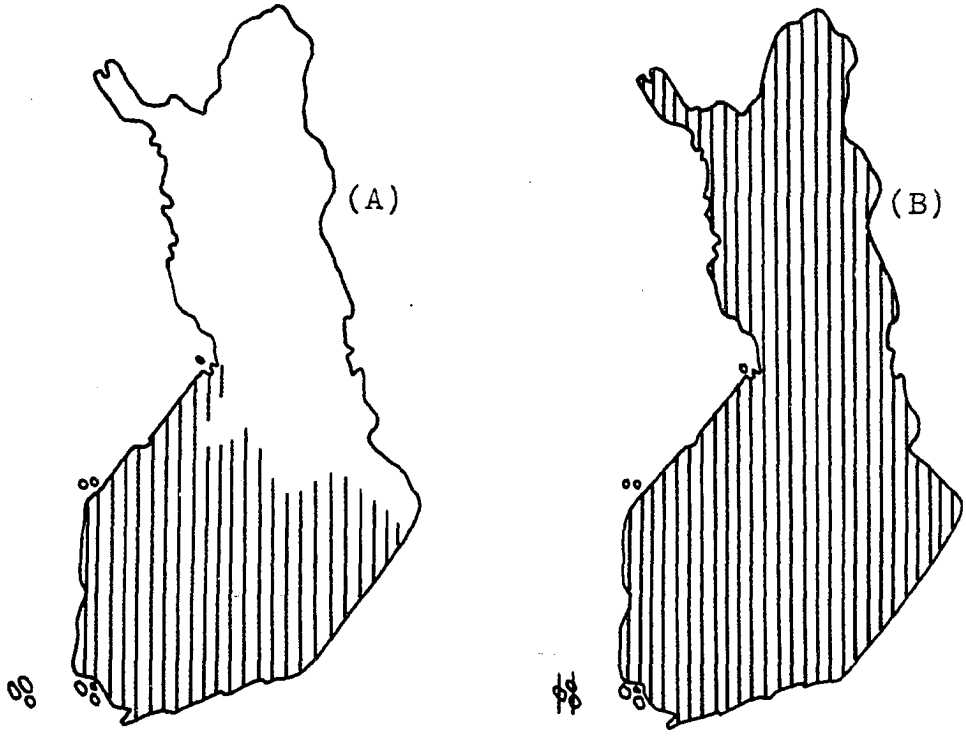

Fig. 10. Distribution of the European hare, Lepus europaeus, (A), and the snow hare, Lepus timidus, (B), in Finland (Helminen 1969).

Habitat improvements include similar practices as those done for moose, a fact which is of major importance. This applies especially in the production of suitable winter food. In summer both hare species have a very similar diet, which is composed mainly of grasses and herbs. According to Helminen et al. (1966) species of the Family Papilionaceae (Pea Family) are very important as are Equisetum species. Earlier studies of Seiskari (1963) yielded similar results. Food is usually abundant, and there is no competition between the snow hare and the European hare. In the fall, when there is some snow on the ground, green twigs of blueberry, Vaccinium myrtillus, and other green plant material above the snow are used. Later in the winter willows, Salix cinerea and S. phylicifolia, become important (Seiskari 1956, Nyholm 1968). When forests have been cut, pine is sometimes also eaten (Nyholm, op. cit.). Where aspens have been cut down for hares and moose, trunks and branches are rapidly cleaned of bark. Because the winter home range of the snow hare is quite small, proper feeding shelters are especially useful in winter feeding. The edges of logged areas are suitable for this purpose because treetops and branches there provide cover and some additional food as well. Hay is commonly used in the winter feeding shelters and it is eagerly eaten by the snow hare. Winter feeding may not be necessary for the existence of the snow hare, but when combined with controlled hunting it usually brings about very

rapid increases of location populations (Suomus and Mäki 1968).

The European hare, living in Finland in the marginal area of its range, is somewhat more dependent upon winter feeding than the snow hare (Rajanto 1968). In game fields the European hare may dig forage cabbage under a thin layer of snow, but it is better if the crop is harvested and stored and provided later in the winter at the feeding shelters.

In general the agricultural areas of Finland seem to be suitable for the European hare. Where farming is very intensive and large areas are cultivated, cover may be a limiting factor. Hedges and "islands" of natural vegetation in the middle of large fields usually solve this problem (Nyberg 1968b).

Where artificial winter feeding is provided there are some precautions to be taken. There must always be enough food for continuous feeding during a long and severe winter. Beginning of winter feeding should be adjusted according to the weather conditions. When started, feeding should be continued until enough food is available in nature. In the spring all feeding places should be cleaned and left-over food and accumulated feces burned or disinfected by using lime (CaO) to avoid the spreading of diseases (Rajanto 1968). Lampio (1953) observed a rapid increase and healthy condition of an island population of the snow hare at the

time when the trend of the cycle was downward in the other areas. This was achieved by careful cleaning and use of lime at the winter feeding places of the experimental area into which hares had concentrated during the winter.

The lungworm, Pneumostrongylus pulmonatus, is a very common parasite in Finnish hare populations. During epidemics local populations may be totally infected, but generally speaking this disease does not have strong influence on population welfare (Lahermaa 1951). Helminen (1959) observed in 1957 that 78.3% of hares examined had lungworms, while in 1958 the figure was 83.8%. The epidemics have been observed to coincide with the beginning of declines.

Tularemia was observed for the first time in northern Finland in 1967, and this outbreak had been expected (Andersson 1968). The immediate countermeasure was the delayed opening of the hunting season. The future will show what the effects of this disease are on snow hare populations.

The European hare seems to be more resistant to diseases and parasites than the snow hare (Suomus and Mäki 1968).

Because both Finnish hare species are cyclic, they provide some problems for management (Andersson and Helminen 1964). Along with winter feeding and sanitary practices mentioned earlier, local control of seasons and bag limits is very important. Hunting clubs and game management asso-

ciations have the right to restrict the general seasons and also set bag limits. When populations are again high, normal seasons, as stated in the hunting regulations, may be allowed. This privilege is very often used by sportsmen among which hare hunting is a very popular group sport.

In general the habitat requirements of the hare species in Finland are well known. The management is based on simple practices which usually give good results.

The Ptarmigan, Lagopus lagopus and Lagopus mutus

Alaska

Both ptarmigan species included in this study, the willow ptarmigan, Lagopus lagopus, and the rock ptarmigan, Lagopus mutus, have a very wide range in Alaska. They are absent only from some islands in southeastern Alaska and forested lowlands and major river valleys throughout Alaska. In addition, the rock ptarmigan does not inhabit the wet coastal tundra of the Yukon-Kuskokwim Delta and the arctic coastal plain (Weeden and Ellison 1968. See Fig. 11.).

Unlike the muskrat and hare, the ptarmigan species have received considerable attention during recent years and large-scale field studies are still continuing. Preliminary studies of general life history, population dynamics, habitat

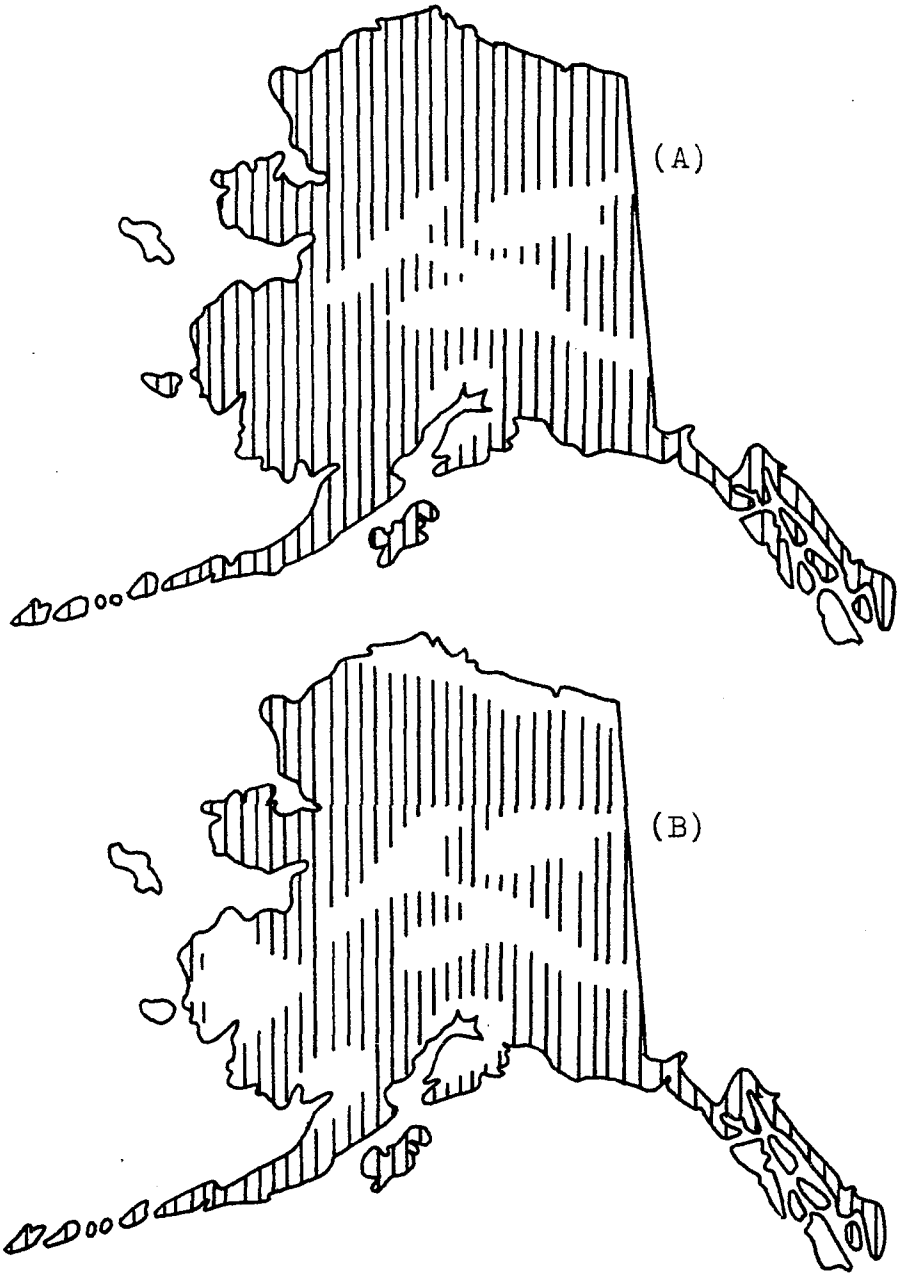

Fig. 11. Distribution of the willow ptarmigan, Lagopus lagopus, (A), and the rock ptarmigan, Lagopus mutus, (B), in Alaska (Weeden and Ellison 1968).

preference and food habits were carried out in the Alaska Cooperative Wildlife Research Unit in the early 1950's by DeLeonardis (1952) and Roberts (1963). Ecological studies with an emphasis on management were done primarily by Weeden (1962, 1963, 1964, 1965b). The recent and continuing studies on the population characteristics of the rock ptarmigan in Interior Alaska have been partly summarized over the period of 1960-1964 (Weeden 1965a). The willow ptarmigan has also been a subject of study at the Institute of Arctic Biology, University of Alaska, where winter migration of the willow ptarmigan in arctic Alaska and the food habits of this bird have been investigated (Irving, West and Peyton 1967, Irving, West, Peyton and Paneak 1967). West and Meng (1966) studied the availability of different kinds of foods, the food preferences and the caloric content of the diet throughout the year. The extensive work of Weeden (1969a), in which some 1,400 crop contents were analyzed, presents a year-around summary of the diet of the willow and rock ptarmigan with remarks on possible interspecific competition.

As a part of a major parasitological research project, the helminth parasites of ptarmigan have also been studied. According to Babero (1953), Ascaridia compar is very common in the willow ptarmigan, and Brachylaima fuscata is common in both species, though particularly so in the rock ptarmigan.

With regard to management practices, experiments to

detect the exploitability of ptarmigan populations are of major interest. This problem is common to all small game species (Weeden 1967). In 1967 and 1968 about 40% of the rock ptarmigan population was removed from an experimental area in Interior Alaska. The results seem to support the assumption that it is possible to remove at least 40% of fall populations without harmful effects (Weeden 1969b, McGowan, unpubl. mat.).

According to Weeden (1963), research is used to provide a basis for sound management in the future, when recreational hunting will cause heavier pressure upon ptarmigan populations. The only current management is through the regulation of harvest. Open seasons are quite long, but there is a possession limit of 40 birds per hunter (Alaska Department of Fish and Game 1969). Accessibility is once again a problem in properly distributed harvesting. Hunting pressure is approximately three times greater along highways than in areas a few miles from the road (Weeden 1967, McGowan and Weeden 1969).

Generally speaking, the information available about ptarmigan in Alaska is extensive enough to provide a basis for more active management when the latter is required.

Finland

The range of the willow ptarmigan in Finland covers almost the whole country. However, in southern Finland

there are only scattered local populations. The rock ptarmigan occurs only in Fell-Lapland (Merikallio 1958). In this region the only suitable habitats of the rock ptarmigan are on the treeless summits of undulating hills and fells (Fig. 12).

The willow ptarmigan has been included in the general management program of Finnish tetraonids (Siivonen 1951). Only a few methods are applicable in the management of tetraonid game birds. Providing suitable habitat is the only one which may give good results over a long period. For the willow ptarmigan preserving and planting of willows, bending down birch tops in winter and preserving suitable underbrush and seedings especially in and around open areas have been mentioned. Uncovering gravel for grit in winter as well as establishing dust bathing places are considered to be beneficial for all forest game birds.

Food requirements and feeding habits of the willow ptarmigan have been studied by Rajala (1966a) and Seiskari (1957). Recent studies on some physiological aspects of this bird have been carried out at the University of Helsinki (Pulliainen, Paloheimo and Syrjälä 1968, Tanhuanpää and Pulliainen 1969). The rock ptarmigan is also included in this large-scale research program. Important data on population fluctuations are annually collected by the route-counts which are carried out for all tetraonids (Rajala 1966c, 1968).

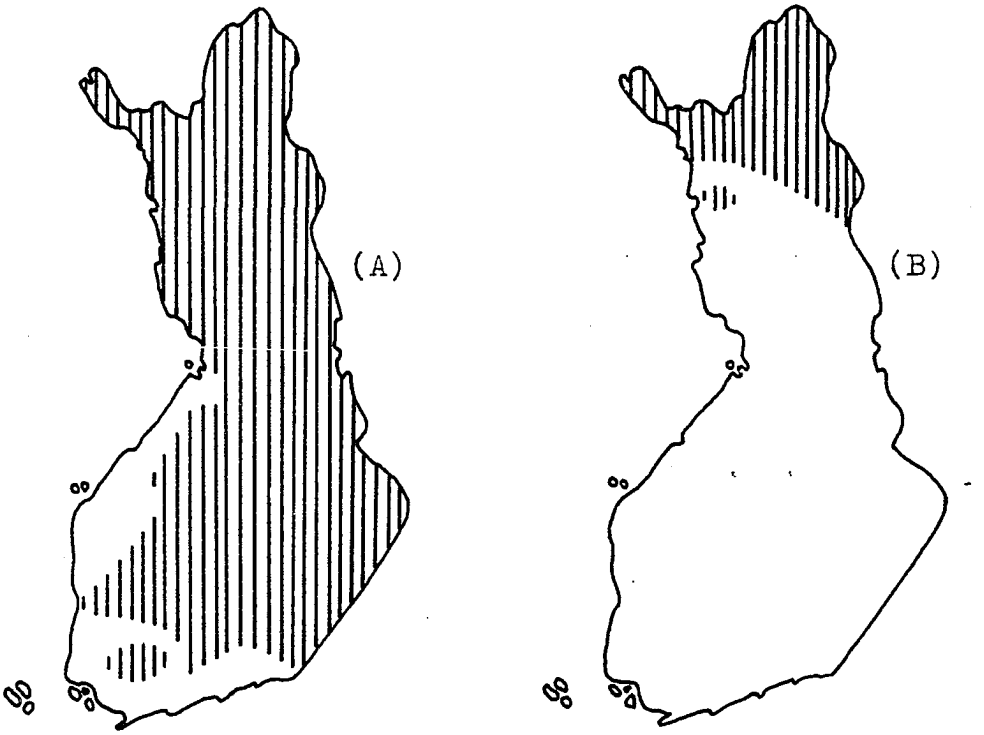

Fig. 12. Distribution of the willow ptarmigan, Lagopus lagopus, (A), and the rock ptarmigan, Lagopus mutus, (B), in Finland (Merikallio 1958, Rajala 1968).

Route-counts are executed in late summer before the hunting season, and two methods have been used (Rajala 1962, 1966b). In one method when a route has once been established it is also used for subsequent counts. Best possible habitats are checked and all game and predator species are included in observations. The recommended total length of a route is 50-60 km. Three men walk abreast keeping a distance of 20 meters between them. All observations are immediately recorded on a map (scale 1:10,000 or 1:20,000) by the leader who is in the middle. When members of a hunting club have summarized the results of various teams they have a good basis for establishing their annual bag limits. The results are then submitted to research personnel for nationwide compilation.

In the second method employed, when information about average bird densities is needed, the counts are executed by using compass-lines instead of routes through the best bird habitats (Rajala 1966b). This method also gives information concerning habitat preferences of various game species. For instance, in the experimental counts in 1966 in the province of Oulu, 60% of all observed willow ptarmigan were in peat-bogs, a favorite habitat of this bird at that time of the year (Rajala 1966b).

Little is known about the summer food of either ptarmigan species. Samples from the early part of the open season (September 1-15) may give some information. Unpub-

lished data from feeding experiments carried out at the Department of Agricultural and Forest Zoology, University of Helsinki, indicate that the willow ptarmigan uses the leaves of blueberries, Vaccinium myrtillus and V. uliginosum, and also the tender green twigs of V. myrtillus, which are very important in the fall diet. Leaves of willows, Salix caprea and S. phylicifolia, are also eaten.

In fall, berries of Vaccinium-species and Empetrum nigrum often make up the bulk of crop contents. Material collected at Värriö Subarctic Research Station in north-eastern Lapland show that the leaves of Vaccinium uliginosum are eaten until they begin to fall. After that the major portion of green material is twigs of V. myrtillus. When these have been covered by snow, buds and twigs of dwarf birch, Betula nana, and various willows comprise the winter diet of the willow ptarmigan. Even then this bird prefers green twigs of V. myrtillus when they are occasionally available. These observations agree with the results of the feeding experiments done by Rajala (1966a) at Meltaus near Rovaniemi. He observed that the birds' preference for Vaccinium myrtillus was three times as high as that for Salix phylicifolia.

As mentioned earlier, the only applicable management practice for the willow ptarmigan in Finland is providing suitable habitat. The same silvicultural practices which are beneficial for moose and the snow hare are also effec-

tive for the willow ptarmigan. Maintaining cover belts around bogs and clear-cut areas, as well as the preserving of willow thickets are among these methods. "Saisa" (1963) observed considerable increase of willow ptarmigan in areas where clearings were small, from 1-7 hectares, but the clear-cut area totalled some 50 hectares. After two or three years underbrush provided both food and cover for the willow ptarmigan. In other studies on the effects of intensive monoculture and on the role of economically important forests as the habitat of all game species the willow ptarmigan has been included among the species considered. In Finland the capercaillie, Tetrao urogallus, seems to be the only tetraonid which can to some extent tolerate monocultures as its habitat (e.g., Mikola 1958, Seiskari 1958, Valleala 1954).

One important plan in the management of the willow ptarmigan in Finland is still to be mentioned. General climatic conditions were unfavorable to the willow ptarmigan in southern Finland during the 1920's and 1930's, and considerable decrease occurred in these populations. After that warm period the climate became colder again, and during the 1950's the southern populations of the willow ptarmigan began to recover (Siivonen 1958, Suomus 1957). Experimental reintroductions have been studied by the Finnish Game Research Institute (Suomus, op. cit.), and the criteria set for obtaining the birds for possible future large-scale

transplantations. Siivonen (1959) states that the geographical distance between the source of birds and the site of their release should be as short as possible. Thus, the sparse populations in southern Finland should be reinforced by birds from the southern part of the main range of the species, i.e., from Ostrobothnia rather than from Lapland. However, it may be remembered that in densely populated southern Finland there is considerable shortage of suitable habitat for large transplantations (Suomus and Mäki 1968).

ECONOMIC IMPORTANCE

The Moose

Alaska

Since the harvest ticket system was adopted by the Alaska Department of Fish and Game in 1963, data on annual harvests of moose have been quite reliable (Rausch et al. 1966). During recent years some 25,000 hunters have been stalking moose every season, and the hunting success has been about 30-40%. Usually about 20-30% of those who obtain harvest tickets do not, in the end, hunt moose. According to Rausch and Bishop (1968) the interest of residents appears to be declining. On the other hand, non-residents are more eager to hunt trophy moose in Alaska (Courtright 1968). The sale of moose tags required for non-residents has increased from 933 in 1964 to 2,000 in 1968 (Burris, unpubl. mat.). Harvests are the greatest in units 13, 14, 15 and 20 (Fig. 2). These areas include the famous Kenai National Moose Range and the area bordering the connecting highway between the major urban centers of Anchorage and Fairbanks (Courtright 1965).

Meat is the most important factor in the economic value of moose. One animal provides about 230 kg (500 lb) meat, although the amount may be as low as 180 kg or as high as

400 kg (Spencer and Chatelain 1953, Courtright 1964). Because moose meat is not marketable in Alaska, there are no data available about unit prices. Steinhoff (1969) uses an arbitrary value of $1.00/lb, $2.20/kg, which he considers to be quite a conservative estimate. Koontz (1968) mentions that during the period 1961 through 1963 there was no meat available in stores in the Yukon Flats area for less than $1.00/lb. At that time the cheapest meat available at Fairbanks was chicken, which sold for about 70 cents a pound. A report to the Bureau of Indian Affairs (Arthur D. Little, Inc. 1963) states that beef from Seattle delivered in Anchorage or Fairbanks had a price of about 70 cents a pound in 1963. In the end of 1969 average meat prices in Fairbanks ranged from 60 cents to about $1.70 a pound, the gross average being $1.20 a pound. This may be accepted as an arbitrary basis for the evaluation of the cash value of moose meat. Assuming that the average rate of increase of the consumer prices (all items) has been about 4% a year from the level of 1964, the unit price of moose meat in the beginning of the compilation period would be about $1.00/lb or $2.20/kg. The values of meat are summarized in Table 2.

One evident source of error is the omission of transportation costs of beef and other meat available at stores in rural population centers. This may cause an increase of about 5-15% over the prices in the nearest larger center (Koontz 1968).

Table 2. Summary of moose-related values in Alaska, 1964-1968.

	1964	1965	1966	1967	1968
Meat:					
kg	1,973,250	1,940,175	1,587,150	1,332,450	1,527,975*
$/kg	2.20	2.29	2.38	2.48	2.57
$/lb	1.00	1.04	1.08	1.13	1.17
Total: $	4,341,150	4,443,000	3,777,420	3,304,475	3,926,895
Tag sales: $	46,650	57,500	68,200	86,300	101,000
Tourist hunting: $ **	56,000	69,000	82,000	104,000	121,000
Total income:	4,443,880	4,569,500	3,927,600	3,494,800	4,148,900
Highway accidents:					
Property dam. $	54,605	50,570	44,495	48,780	74,375
Medical exp. $	2,460	3,320	3,250	3,000	3,000
Total expenses: $	57,065	53,790	47,745	51,780	77,375

* Includes some animals taken during the early spring of 1969.

**30% of non-resident tags sold, estimated expenses $200.00 per hunter.

The total income from non-resident moose tag sales can also be considered as a contribution to the Alaskan economy.

Atwell et al. (1963) report that during a regular season some 4% of all hunters used guides. This percentage is far greater in the case of non-resident trophy hunters. Courtright (1965) mentions that during the 1963 season 196 moose were taken by 209 guided hunters. Non-resident moose tags sold in 1963 numbered 796. If it is assumed that about 30% of the non-resident moose tag purchasers came directly from out of the state and usually hire professional guides, the income, based on an arbitrary sum of $200 per hunter over the whole compilation period, can be calculated. These amounts are included in Table 2.

Moose meat plays a very important part in the diet of Alaskans, especially of those who hunt for subsistence. On the other hand, many well-to-do people also expend much effort to take a moose annually. Sometimes hides are salvaged for trophies, and especially the natives use hides as raw material for various leather garments, mittens and footwear. These items also find outlets in general markets and are relatively expensive.

Alaskan moose have a remarkable reputation as a trophy animal. Although these indirect economic aspects are largely omitted here, it should be mentioned that the Alaska Department of Fish and Game is already managing some areas with the major emphasis in the production of trophy animals.

The Kenai National Moose Range administered by the Bureau of Sport Fisheries and Wildlife was established for the same purpose.

Damages done by moose in Alaskan forests are presently of apparently minor importance. In the main agricultural area of Alaska, the Matanuska Valley, moose have occasionally caused serious damage to crops, especially oats (Chatelain 1951). Experimental use of weakly charged electrical fences in this area by the Alaska Department of Fish and Game has proved to be effective (Rausch 1964, Burris 1965). Game officials may also remove individual moose which become nuisances in crop fields and in gardens.

Moose, as well as other big game species, are traffic hazards, especially when they concentrate in small wintering areas. There are considerable fluctuations in the annual toll of moose-caused accidents. In general, the period from November to February is the most dangerous.

No statewide summaries of moose-car and moose-train collisions have been compiled by the Alaska Department of Fish and Game (Cornelius, pers. comm.). Atwell et al. (1963) and Rausch (1965b, 1967) present some regional data for short periods of time. In the Anchorage district from 1959 to 1965 the number of train kills totalled 287 of which 244 occurred during one year, from July 1961 to July 1962, although most of these occurred during winter. The number of highway kills was 279 in total. The Alaska Department of

Highways does not have statewide compilations (Henderson, pers. comm.). This department has, however, statistics of the total numbers of animal collisions starting from 1960, excluding the collisions occurring inside the boundaries of urban centers with 2,500 or more people. The highway officials estimate that moose were involved in 90% of these accidents. The moose mortality data from the Anchorage-Matanuska-Lower Susitna Valley area presented by Rausch (1965b) shows that about 22% of the accidents were moose-train collisions. Actual damage costs are not known, but Rausch (1958) mentions that they have amounted to thousands of dollars annually.

Average property damages in moose-car collisions have been given as $850, with medical expenses averaging $125 per accident (Steinhoff 1969). Fatal accidents seem to be rare; none were reported during the period of 1964-1968 (Henderson, pers. comm.). A summary of estimated costs of moose-car accidents based on the information from the Alaska Department of Highways is included in Table 2. The original data are included in the Appendix, no. III.

Finland

The recent work by Lampio (1968) was the first serious effort to describe the pattern of moose hunting in Finland. Although this material contains information from only 4.9% of the total harvest in 1966, it provides a preliminary view

of the situation. The impact of tourist hunters, mainly from Scandinavia (Sweden) and central Europe (Germany), is a very recent phenomenon (Lampio 1969a). Special hunting trips to Finland were introduced in 1967 by a Finnish shipping company, Oy Finnlines, Ltd. Moose damages to young forests, on the other hand, were already receiving attention by foresters in the end of the last century. Principles of avoiding moose damages in forests and especially in pine plantations have been developed as a result of studies by Kangas (1949), Sainio (1956a, c, 1958) and Yli-Vakkuri (1956). Methods of avoiding damages to agricultural crops have also received some attention (Sainio 1956c).

According to Lampio (1968) some 43,700 sportsmen, 26% of those who had purchased their general hunting licenses, participated in moose hunting in 1966. This represents a 60% increase from 1953 when the percentage was 16.5%. In addition, the number of sportsmen has almost doubled during that period. Moose hunting in Finland is usually a group activity except in Lapland where hunters often stalk moose alone.

The average size of a hunting party is 14 sportsmen with the usual variation being from two to 20. The average time spent in moose hunting in most provinces is 7 to 9 days and rarely more than 15. In 1966, when 9,092 moose, including 942 calves, were taken, the total yield on the basis of dressed weight was 1,559,690 kg. This gives some

30 kg per hunter with the provincial variation from 18 to 72 kg. The cash value of this harvest was Fmk 6,082,800 ($1,889,800) based on a very conservative price of Fmk 3.90 ($1.20)/kg given by a major meat distributor, Karjakunta, as their whole carcass buying price (Mäki, pers. comm.). According to the same source the unit price in 1968 was Fmk 4.60 ($1.10)/kg, and the cash value of 1,216,320 kg of moose meat totalled Fmk 5,595,100 ($1,338,540). Meat of accidentally killed, poached and confiscated moose is usually sold at auction, and the income is surrendered to the state. The price is generally higher because there is no middleman involved; in 1968, for instance, the average price in these cases was about Fmk 6.00 ($1.45) per kilogram. In cases where selected parts are sold to restaurants prices may reach Fmk 28.00 ($6.70)/kg (Lampio, pers. comm.). Cash values of moose meat during the period 1964-1968 are summarized in Table 3.

Hides and antlers are quite often salvaged, although Finnish hunters generally do not as yet consider these as trophies of any significant value (Rajanto, pers. comm.). In the general agreement between the travel agencies and the Central Organization of Hunters it was accepted that a tourist hunter receives the head, the tongue, the antlers and the hide if he wants them (Rajanto, pers. comm.). Tourist hunting in Finland is presently a new but growing industry, although it cannot ever be of great importance unless

Table 3. Summary of moose-related values in Finland, 1964-1968.

	1964	1965	1966	1967	1968
Meat:					
kg	1,329,240	1,463,280	1,559,690	1,375,640	1,216,320
Fmk/kg	3.70	3.80	3.90	4.30	4.60
Total, Fmk	4,918,200	5,560,500	6,082,800	5,915,250	5,595,100
Income from permit-fees:	761,240	848,840	876,160	1,300,585	1,086,410
Damages compensated	241,750	355,540	278,670	328,460	394,300
Surplus	519,490	493,300	597,490	972,125	692,110
Travel agencies: *)				15,000	60,000
Hunting clubs: *)				2,500	10,500
Total income: Fmk	5,437,690	6,053,800	6,680,290	6,904,875	6,357,710
$	1,688,725	1,880,060	2,074,625	1,651,885	1,520,985

*) Estimates based on the numbers of visitors and average expenses per individual.

game management receives increased attention by the representatives in Parliament. According to estimates from two leading travel agencies (Luukkonen, Piltz, pers. comm.), the income in 1967-1968 was approximately Fmk 75,000 ($17,940), and some 100 participants spent about Fmk 10,000-15,000 ($2,400-3,600) locally. The latter expenditures are not itemized or separated on the basis of regional distribution.

As mentioned earlier, the funds derived from moose permit fees are not earmarked for game management. Damages to forests and agricultural crops as well as to motor vehicles caused by moose are compensated for from these funds. The surplus goes into general funds of the state. Sometimes, as in 1964 and 1965, some of these monies may be specially appropriated for game management in addition to the regular financing. Permit fee income, damage compensations and surplus amounts during the period 1964-1968 are presented in Table 3.

The major importance of moose hunting is in its recreational aspect although trophy values are not especially appreciated. In the northern part of Finland and above all in the province of Lapland the annual moose means a considerable help in the economy of many families. The fact that smaller parties and solitary hunters are more common in the north (Lampio 1968) is explained by a greater need of meat by the hunter for subsistence. Local residents, as mentioned earlier, can use state-owned lands to some extent for hunt-

ing (Kytömaa 1965). When the dressed weight of the Finnish moose averages some 180 kg (Lampio 1968) and the price of Fmk 4.60 ($1.10)/kg is applied again, the cash value of one moose in 1968 was at least Fmk 830 ($200). When the permit fee, Fmk 130 ($31.10) for an adult animal, is deducted, the net earning still is Fmk 700 ($170), which can be considered equal to a moderately good monthly net salary.

There is no recent information about the importance of wildlife resources in the economy of these northern rural areas. In the study by Lampio (1954), which was conducted in 1953, a questionnaire, which covered some 15% (14,362) of Finnish hunters at that time, revealed that in the provinces of Vaasa, Oulu and Lapland from 13.4% to 43.3% of the hunters considered game as a necessary addition to their economy. On the other hand, market hunting of most edible game was indefinitely prohibited by Parliament in the fall of 1953, a fact which evidently affected the results. However, at that time on a nationwide basis about 77% of Finnish sportsmen considered their hunting activities as mainly recreational. Only 11.7% thought that wildlife had a necessary role in their family economy.

Due to the continuing decrease of moose populations in the late 1960's, the number of permits was drastically reduced for the 1969 season. No permits were issued in the provinces of Mikkeli, Kuopio, Central Finland and North Karelia (districts 7-10, Fig. 4), and elsewhere the reduc-

tion was about 30-50%. The total number of permits was down to 4,052 for adults and 665 for calves, and in 1968 the figures were 8,105 and 504 respectively.

Detailed information on the economic importance of moose is lacking because no large-scale studies on this problem have been executed. Tourist hunting seems to have at least some indirect importance, especially in Lapland, which attracts Swedish hunters (see Lampio 1969a). And, in general, there is some evidence that income from hunting trips arranged by travel agencies will finally reach sparsely populated rural areas, i.e., the areas where this income is more needed than in agricultural-industrial southern Finland.

The Muskrat

Alaska

Although the accuracy of harvest data is still uncertain, those concerning furbearers are evidently more reliable than those of small game (Burris 1969). These data are compiled from the purchase and exportation reports submitted by trappers and dealers.

The muskrat usually contributes the greatest number of pelts to the annual harvests. For the muskrat there are also real market prices available. The price has been quite

stable during recent years, being about $1.00 for a prime pelt (Buckley 1957, Burris 1966). From the 1966-1967 season the price has been somewhat lower, being about 60 to 80 cents (Burris, unpubl. mat.). The number of trappers has been about 8,000-10,000; probably less than half of them could be considered full-time trappers (Courtright 1964).

The muskrat harvest comes from limited areas (Burris 1966). During the 1966-1967 season game management units 18, the Kuskokwim Delta, and 25, the Yukon Flats and back-country, yielded the major portion of the total harvest, 19,800 and 13,300 pelts respectively (Burris 1969). It is apparent that the income from this particular fur species is not evenly distributed and thus has a considerable local and even individual importance. The harvests have fluctuated widely from less than 30,000 in 1965-1966 to more than 500,000 in 1941 (Courtright 1964, Burris 1969).

From the Yukon Flats area there is detailed information available which describes the importance of the muskrat in village economies. Dean and Klein (1962) reported that this area, which in 1962 had about 1,600 inhabitants, yielded during the period from 1958 to 1962 about 19.5% (3.3-37.7) of the total muskrat harvest in Alaska. The average price per pelt paid to trappers in the area was about 60 cents (Koontz 1968). Fur resources in the area were utilized almost exclusively by native residents. During a single season, 1960-1961, one trapper caught 1,700 muskrats worth

approximately $1,000.

The long trapping season and some of the methods used account for the low quality of many pelts. Scott (1951) mentions that the Seattle Fur Exchange classified about 35% of Alaskan muskrat pelts as damaged. The major reasons were that the animals were shot, that they had been taken too late in spring so that fighting had caused some damage and finally that the general preparation of the pelts had been poorly done. The losses in income were stated by Scott (op. cit.) to be some 35%. According to Kellogg (1947) the highest returns come from muskrats which have been trapped in winter. Dederer, President, The Seattle Fur Exchange (pers. comm.), mentions that muskrats trapped in Alaska in wintertime are usually in the highest quality class. Fur values are presented in Table 4.

There are several reasons which explain the pattern of muskrat harvesting in Alaska. According to Burris (pers. comm.), in spite of the long season only about 5% of annual catches are taken outside the spring breakup period when muskrats are most active. Muskrat shooting is often associated with beaver trapping and is then of secondary importance. The large majority of animals are shot simply because the use of cal. .22 rifle is very cheap when compared with the price of about 100-150 steel-traps required for a full-length trap-line. And, in general, trapping in wintertime is not feasible due to ice and snow conditions, espe-

Table 4. Summary of fur and meat values of the muskrat in Alaska, 1964-1968.

	1964	1965	1966	1967	1968
No. of pelts	49,000	38,800	27,100	41,300	48,600*
$/pelt	1.00	1.05	1.00	0.60	0.80
Total: $	49,000	40,700	27,100	24,800	38,900
Meat:					
Human consumption: kg	5,515	4,365	3,050	4,650	5,470
$/kg	1.67	1.74	1.81	1.88	1.95
$/lb	0.75	0.78	0.81	0.84	0.88
Total: $	9,210	7,600	5,520	8,740	10,670
Dogfood: kg	16,540	13,095	9,145	13,940	16,400
$/kg	0.44	0.46	0.48	0.50	0.51
$/lb	0.20	0.21	0.22	0.23	0.23
Total: $	7,280	6,025	4,390	6,970	8,365
Total income: $	65,500	54,300	37,000	40,500	57,900

* Unpublished figures (Burris, pers. comm.).

cially when the pelts are of limited value.

Muskrat meat in some areas is used as food for both humans and dogs. If the weight of a muskrat carcass is estimated as 450 g (about 1 lb), and it is assumed that some 25% is used in human consumption, it is possible to obtain rough estimates for this additional value of the muskrat. Koontz (1968) reports 75 cents as the going price on muskrat carcasses in 1963 at Fort Yukon in the Yukon Flats area. This price apparently refers to the value of meat for human consumption only. For the portion used as dogfood it seems acceptable to use the unit price also provided by Koontz (1968), which in 1963 was 20 cents a pound. It is also assumed here that all muskrat carcasses are used. Using these figures, the estimated values of muskrat meat are summarized and included in Table 4.

Finland

After its introduction into Finland in the 1920's, the muskrat reached peaks of abundance four times: in 1937, 1950, 1955 and apparently also in the late 1960's. The record catch was in 1955 when 602,949 pelts were stamped. The muskrat, which was introduced mainly for economic reasons, reached its peak of importance during the period 1947-1955. After World War II the standard of living in the rural areas of the nation was relatively low, and the rapidly increasing muskrat population provided an easy op-

portunity to make additional money. During the period of 1958-1968 the average price of prime pelts fluctuated between Fmk 5.50 (1963-1964) and 3.80 (1959, 1967). These are prices paid to trappers and based on the information from the leading fur-firm, Turkiskauppiaiden Oy, Fur Skin Exporters, Importers & Merchants, which currently buys 10-20% of the annual harvest and, before 1955, when raw pelts were still exported, bought some 30-40% (Heikkilä, pers. comm.).

There are some factors which tend to reduce the economic importance of the muskrat in Finland. First, the open season is quite short, and when it occurs in April and May it coincides in south Finland with the busiest period in farming. Southwestern Finland is the best muskrat area in the country (Artimo 1949, also Helminen 1969, p. 124), but it is also the region of the most intensive farming. Thus, although the resource is available, utilization is far short of the maximum level. Much of the trapping is done by youngsters. According to Lampio (1954) only some 3% of Finnish sportsmen were interested solely in fur animals. In rural areas wildlife harvesting is generally mixed, and the urban people mostly hunt only edible game.

Another factor is the distribution of the muskrat, which avoid oligothrophic waters which are abundant in Lapland (Artimo 1949). Thus, the muskrat is more available to the people living in more prosperous rural areas in south

Finland, and even there it benefits those groups for which income of this sort is only supplementary.

Third, during recent times the role of the muskrat as a furbearer has decreased mainly due to a lack of interest, which again is the result of better living standards. Pelt prices are still reasonably high, Fmk 4.25 ($1.00) in 1968, and populations could be harvested more intensively. The Central Organization of Hunters is trying to divert the increasing interest in sport hunting to underharvested resources, which include the muskrat.

Fur values over the period from 1964 to 1968 are summarized in Table 5.

In spite of the information about the quality of the meat of the muskrat (Dozier 1952, Ingo 1953), it is seldom used except sometimes as dogfood. This unused meat can be considered as biological waste, with losses amounting to hundreds of thousands of Finnish marks every year.

Table 5. Summary of cash value of Finnish muskrat pelts, 1964-1968; 10% of the pelts are considered to be in the second quality class (Heikkilä, pers. comm.).

		1964	1965	1966	1967	1968
No. of pelts		131,842	124,638	140,048	218,563	191,612
Fmk/prime pelt		5.00	4.50	5.50	4.00	4.25
Total income:	Fmk	626,250	532,830	731,750	830,540	773,730
	$	194,490	165,475	227,250	257,930	185,100

The Hare

Alaska

The annual harvest data currently available for hares are only estimates. These are based on questionnaires completed by hunters buying their new licenses. In 1961, a questionnaire was mailed to all full-fee license holders. These samples exclude the holders of the subsistence license (Courtright 1968), who are mainly natives, and the proportion of the annual harvest bagged by them is certainly important. A 10-year average (1948-1957) of the annual take is 83,000 hares, and usual estimates are over 50,000 hares per season, exclusive of the native take (Courtright 1964, 1965, 1968). By comparison, according to Koontz (1968), the average hare harvest in the Yukon Flats area is approximately 25,000 a year. The area studied included 147 households and about 1,200 residents, primarily natives, who were greatly dependent upon small game and furbearer resources for their livelihood.

The results of the studies by Woolford (1954) and Kozely (1964) strongly emphasize the fact that native villages which are only little integrated rely strongly upon wildlife resources. In addition to the meat of the hare, skins are also utilized, but, in general, their importance is not very great (Buckley 1954, Koontz 1968).

The cash value of hare meat may be calculated by using

as a unit price $1.76/kg (80¢/lb) in 1964 (Koontz 1968). The portion used as dogfood is priced as 44¢/kg (20¢/lb). It is assumed here that about 25% of the hares are used as dogfood. Based on an average annual harvest of 80,000 hares, the estimated annual cash values of meat are presented in Table 6.

There are some cases in which hares have been reported to have caused damage to agricultural crops (Buckley 1954). This occurred during the population high in 1924-1925. Walker (1923) reports that competition for food existed between snowshoe hares and moose on the Kenai Peninsula during the winter of 1922-1923.

Forest damages are apparently of minor importance. The snowshoe hare is, however, a potential pest of young woody vegetation under natural conditions and in plantations (e.g., Walker 1923, Corson and Cheyney 1928). On the other hand, there is also the opposite opinion that hares may be useful in thinning overdense young stands (Cox 1938). Results obtained from research elsewhere in North America (e.g., Besser 1955, 1957) will apparently be applicable in Alaska when required by intensified forestry.

Although the populations of the Alaskan hare species fluctuates tremendously, they are a very important part of the diet of people living in scattered villages in the wilderness. Even in the cases in which hare meat replaces the cheapest meat available in stores, its value in the rural

Table 6. Summary of the meat value of hares in Alaska, 1964-1968.

A mean annual harvest of 80,000 hares is estimated. 75% is used for human consumption, 68,100 kg, and 25% is used as dogfood, 22,700 kg.

	1964	1965	1966	1967	1968
Human consumption:					
$/kg	1.76	1.83	1.90	1.97	2.06
$/lb	0.80	0.83	0.87	0.90	0.94
Total: $	119,860	123,940	129,390	134,160	140,290
Dogfood:					
$/kg	0.44	0.46	0.48	0.50	0.51
$/lb	0.20	0.21	0.22	0.23	0.23
Total: $	10,000	10,440	10,900	11,350	11,580
Total income: $	129,900	134,400	140,300	145,500	151,900

economy is remarkable.

One aspect of the indirect importance of the snowshoe hare is its role as a major prey of the lynx, Lynx canadensis, which is a furbearer with relatively high pelt price.

Finland

Hares are certainly among the most important game animals in Finland. Recreational and related values are at least as great as the value of the meat alone. These, although they are reflected in the meat price, are not discussed in detail in this review.

According to Lampio (1954) hares did not have an important role when market hunting was legal in the whole country. Tetraonid birds made up the bulk of the harvests sold at that time. Hares are taken mainly for sport in Finland. Hunting parties are usually active regardless of fluctuating populations and variable hunting success. Thus, during the seasons of low hare populations, the recreational aspect of hare hunting certainly is of major importance.

The cash value of meat constitutes the major portion of the direct income from hares. Skins are only seldom used and thus are of minor importance. Meat values are presented in Table 7. Rajanto (pers. comm.) estimates that in 1969 the meat value of a snow hare was about Fmk 20-40.00 ($4.80-9.50) and that of the European hare about Fmk 35-60.00

Table 7. Summary of the meat value of hares in Finland, 1964-1968.

		1964	1965	1966	1967	1968
kg		421,308	347,036	390,154	370,610	379,357
Fmk/kg		8.00	8.50	9.00	9.50	10.00
Total income:	Fmk	3,370,460	2,949,810	3,511,390	3,520,800	3,793,570
	$	1,046,730	916,090	1,090,490	842,300	907,550

(8.40-14.40). When the dressed weights of these animals are considered, 2-3 kg for the snow hare and 3-5 kg for the European hare, the unit price of hare meat in 1969 was then about Fmk 11-12.00 ($2.60-2.90)/kg. To account for the annual rise in cost of living from 1968 to 1969, the unit price of Fmk 10.00 ($2.40)/kg in 1968 is used as the basis of the value compilation. The price of moose meat increased some 25% from 1964 to 1968 (Mäki, pers. comm.). After setting the price for hare meat in 1968, the same rate of increase is applied. This provides the unit price of Fmk 8.00 ($2.50)/kg for hare meat in the beginning of the compilation period. Prices for hare meat are considerably higher than those for moose meat mainly due to various indirect aspects. In Europe, however, game meat is traditionally considered to be of greater value than meat from domestic sources, such as beef.

Another aspect of the economic role of hares in Finland is the amount of damages caused by these species. Damages to agricultural crops are of minor importance. The European hare, however, is a potential pest in orchards. This species is generally more abundant than the snow hare in the southwestern part of Finland, which is the orchard region of the country. According to questionnaires reviewed by Kanervo (1953), orchard damages were estimated at about Fmk 500-600,000 ($215-260,000) in 1951 and about Fmk 350-

400,000 ($150-170,000) in 1952.[4] The orchard owners also expressed the opinion that only about 1% of the damage was caused by the snow hare. The questionnaire of the Department of Pest Investigation (DPI), Agricultural Research Center, showed that the average percentage of damaged trees in the whole country was 4.6% in 1955-1956 and 1.8% in 1956-1957. The provincial damage percentages varied in the major orchard region from 1.2% to 17.8% in the winter of 1955-1956 and from 0.8% to 6.9% in 1956-1957 (DPI, unpubl. mat., Kanervo, pers. comm.).

The damages were remarkably large, although the sums are not very high, because only about 1/5 - 1/3 of the orchard acreage was not protected by wiremesh fences.

Fencing and chemical repellents are the control methods recommended to reduce hare damages to orchards. Also, since the hare is always considered as a pest when in an orchard or garden, it may be killed at any time of the year regardless of the open season.

The Ptarmigan

Alaska

According to a survey made in 1962 (Courtright 1964)

[4] $1.00 = Fmk 2.31

the annual harvest of ptarmigan in Alaska varies between 50,000 and 150,000 birds, depending on the phase of the abundance cycle. It should again be remembered that questionnaires upon which these data are based have excluded subsistence hunters, who evidently bag a remarkable portion of the real annual take. Based on these questionnaires, the average over a 10-year period (1948-1957) is about 83,000 birds annually. It seems that increasing numbers of ptarmigan are being taken mainly for sport by people who are not dependent on wildlife resources, although at the moment this type of take still is quite limited (Weeden 1963).

Ptarmigan are used only for human consumption even when numerous (Culver 1923, Weeden 1963). Koontz (1968) mentions that a grouse furnishes about 340 g (3/4 lb) of meat. A sample of 24 dressed rock ptarmigan collected in springtime averaged 230 g (Modafferi, pers. comm.). Irving et al. (1967a) report the weights of 1,190 willow ptarmigan, when crops were removed, as between 512 and 618 g. It seems feasible to use Koontz's (1968) estimate of 340 g of meat per bird when calculating the value of ptarmigan. As in the case of hare mentioned earlier, the estimates on the cash value are based on the meat price of $1.76/kg (80¢/lb) in 1964. A mean annual harvest of 80,000 birds is also assumed. The values are summarized in Table 8.

As Weeden (1965b) mentions, no adequate survey has been done on the present utilization of ptarmigan in Alaska.

Table 8. Summary of the meat value of ptarmigan harvest in Alaska, 1964-1968.

A mean annual harvest of 80,000 birds is assumed.
Amount of meat: 340 g per bird, total 27,200 kg per year.

	1964	1965	1966	1967	1968
$/kg	1.76	1.83	1.90	1.97	2.06
$/lb	0.80	0.83	0.87	0.90	0.94
Total income: $	47,900	49,800	51,700	53,600	56,000

DeLeonardis (1952) refers to market hunting during Territorial days. Woolford (1954) only mentions the utilization of ptarmigan in villages of arctic Alaska, where they share a substantial role of importance with moose and hare.

Although presently most of the ptarmigan range has only limited accessibility and the hunting pressure remains light, the recreational aspect of ptarmigan hunting will evidently soon become of increasing economic importance.

Finland

In Finland, willow ptarmigan are distributed so that they are more abundant in the areas where wildlife resources are an important part of the rural economy (e.g., Rajala 1968). Market hunting of upland game was prohibited in 1953 (Lampio 1954), but an exception remained which allowed market hunting of both the willow and the rock ptarmigan in Enontekiö, Inari and Utsojoki, the three northernmost communes of Lapland. There the open season is one to two months longer (from September 10 to the end of March) than in the other parts of the province. The use of snares and the .22 cal. rifle are allowed. These special exceptions indicate that the ptarmigan is an important resource in the north. Although accurate harvest data are not available, the 10% samples collected by the Central Organization of Hunters (Rajanto, pers. comm.) give estimates of annual harvests during the period 1964-1968. These figures range from

26,790 birds in 1966 to 47,450 in 1967. The Bureau of Fisheries and Game estimates that approximately 50% of the annual harvest is taken in those three communes where market hunting is legal (Mäki, pers. comm.). It is certain that the income from ptarmigan hunting is shared by a small number of at least seasonally professional hunters and their families. Some households may rely strongly upon the income from this source. During the period 1964-1968 about 1,150 hunting licenses were sold annually in these three communes (Puttonen, pers. comm.).

Ptarmigan, which are mainly sold to restaurants in southern Finland and also directly to Norway and Sweden, show greater price variation than other marketable game. Mäki (pers. comm.) estimates the price per bird as Fmk 4.00 (95¢) and Lampio (pers. comm.) about 5.00-6.00 ($1.20-1.40) in 1968. On the other hand, two hunters report price fluctuation during the compilation period of this work as well as during a single season to be from Fmk 3.75 to 5.00 (Pulliainen, pers. comm.). The supervisor of the game management district of Lapland reports that the numbers of ptarmigan sold have varied from 16,500 birds in 1965 to 24,500 birds in 1964 (Puttonen, pers. comm.).

The role of tourism in this case is impossible to detect. Some hunting clubs have leased hunting rights in certain areas of northern Finland, so that their associated travel and living expenses may contribute a little to the

local economy. There are no separate records indicating how much and what kind of game tourists have bagged (Lampio 1969). Puttonen (pers. comm.) mentions that they take less than 1% of the total annual ptarmigan harvest. Although ptarmigan are important in the economy of Fell Lapland, other tetraonids certainly are more attractive to hunting tourists.

The market values of ptarmigan harvests from 1964 to 1968 are compiled in Table 9. The major portion is, of course, made up by the more abundant willow ptarmigan; the rock ptarmigan has a more restricted and scattered distribution and is only locally of some importance.

Review of the Value Compilations

The figures describing the values of these game species are, at best, only estimates. Those figures which are based on current market prices or detailed nationwide or statewide compilations are most accurate. True values of moose meat in Alaska and Finland are apparently somewhat higher than presented in the tables. The item index for meat has sometimes increased more than the 4% a year average which was used, therefore accounting for the lower values of the estimates. For Finland, the lowest available prices of

Table 9. Summary of the market value of ptarmigan harvests in Finland, 1964-1969. An average price of Fmk 4.75 is used over the whole compilation period.

		1964	1965	1966	1967	1968
No. of birds		33,347	32,791	26,786	47,452	40,303
Est. no. sold *)		24,500	16,500	17,000	23,500	21,000
Total income:	Fmk	158,400	155,760	127,230	225,380	191,440
	$	49,190	48,370	39,510	53,920	45,800

*) Estimates by Puttonen (pers. comm.).

meat have been used; thus the cash values presented should be considered conservative estimates. In contrast, the monetary value of the Finnish hare harvests are quite high, not because of the quality of the meat but, apparently, due to the many indirect values associated with hare harvests. It should be remembered that since 1953 hare meat has not been marketable in Finland, and it has never played an important role in market hunting. Thus, these figures may be considered as over-estimations.

In general, however, the estimates of the total monetary values of the annual harvests of these animals are too low rather than too high because the major portion of indirect values, such as hunting expenditures, have been omitted. If recreational experience is emphasized, meat and fur can be considered as bonuses, providing value additional to the total value of recreation experience. Or, if meat is considered as the objective of a recreation experience, its value should be deducted from the value of the recreation experience. Moose meat usually is included in this category (Steinhoff 1969).

If the actual cash value to the hunter is emphasized, the net value of meat and fur to him is the gross value minus hunting expenditures. From this point of view, since expenditures are not considered in this work, the estimates given would be greater than the actual cash value to the hunter from these resources.

SUMMARIZING DISCUSSION

In the previous descriptive sections the major features of management practices and the role of the particular game species have been presented simultaneously. Comparisons of specific problems are possible and are presented here on the basis of information included in the previous chapters.

Organization

Comparison of the status of game management organizations in Alaska and Finland show some important differences. The Alaska Department of Fish and Game is one of the most important branches of the state administration. Because of the principles stated in the Constitution of the United States, that wildlife resources belong to the people and the responsibility of management belongs to each state, this state department must exist.

The advantages of this departmental system are evident. Various sectors work together to form an effective team. Such fields as research and protection appear to function more smoothly and with better cooperation than if these responsibilities were divided up and shared by various authorities. However, basic sharing does exist at two levels: (1) federal-state; and (2) wildlife managers-land (habitat) managers. This leads to yet unsolved prob-

lems in program and purpose cooperation. In Alaska, where most of the land is publicly owned and administered by the federal or state governments, the departmental organization has decided advantages. It is difficult to imagine any organization similar to that based on voluntary cooperation of sportsmen in Finland. The area of the state and the low population make the latter form unrealistic. Thus, under such circumstances, even a small group of professionals can accomplish more than sportsmen's associations.

Sportsmen in Alaska, however, have opportunities to express their opinions to local advisory committees and, through them, to the Board of Fish and Game, or they may make recommendations directly to the Board. The function of the management organization is not dependent upon active participation of sportsmen; rather the sportsmen's own initiative determines their influence on programs for the management of wildlife resources. Sportsmen's associations may also act as pressure groups which can interfere with management programs.

On the other hand, when sportsmen do not share in the responsibility for game management, there exists the danger that they tend to act simply as harvesters without having interest in management problems. Conversely, when wildlife belongs to the people, every layman has the right to speak as an owner of the resource. Difficulties certainly arise if professionals are considered to be merely public servants

rather than responsible scientists.

The major weaknesses of the departmental system, such as found in Alaska, is that political appointees may hold important positions. Party loyalties may be more substantial than professional competence. Political ambitions are often not coincident with the management and utilization of living organisms and major manipulations of the environment in general.

Changes in the pattern of the land ownership apparently will not alter the effectiveness of the departmental system in Alaska in the near future.

The Finnish system, although defined in the law, is completely non-political, and, at the lowest level, is completely based on the voluntary cooperation of sportsmen. This is understandable because most of the land is private, and the right to hunt is associated with land ownership. This tradition, about 1,500 years old, dates from the dawn of Finnish settlement. The Bureau of Fisheries and Game, a governmental office under the Ministry of Agriculture, is responsible for the control of various wildlife-related activities. The State Game Research Institute was originally established by the Finnish Game Foundation and turned over to the government after the new hunting law passed in 1962. The Central Organization of Hunters, an education, information and management branch of the Finnish system, actually inherited its duties from a major national association of

sportsmen.

The cooperation between these various sectors has been quite good. However, the cooperation and coordination between the institutes and university departments which carry out game research could be better. This is particularly important when funds and professional personnel are both limited. In the field of practical management the major obstacle is still the lack of knowledge and interest among numerous sportsmen, a fact which is reflected in the activity of some game management associations. During recent years a trend toward better direction has been observed.

At the level of the game management association this voluntary system has some advantages. Seasons, which are set by the Ministry of Agriculture, are quite long, and there are no district or nationwide bag limits. Management-conscious associations may determine how much they can harvest and when it can be done without having to get approval from any superior level of the organization. Sportsmen thus are relatively free to formulate local policy. When the hunting grounds controlled by hunting clubs are considered private, there is little danger that hunters from other areas will move in. The Central Organization of Hunters and game management districts have only recently requested that the seasons set by various hunting clubs not be extremely varied, so that major difficulties in control

could be avoided.

One inherited weakness in the Finnish system is that land ownership and hunting rights are linked together. It could be stated that nowhere in interior Finland is hunting absolutely free. Even the residents of certain northern communes have hunting rights on only those state lands within the commune of their residency. Hunting clubs may also limit the number of members who are not landowners. Some communes and parishes may refuse to lease their lands to clubs or individuals, and by doing so keep them closed not only to hunting but also to game management. Some hunting clubs use a credit-point system, so that active participation in management work can increase the individual's bag limit. An individual can overcome the problem of restricted accessibility to hunt by securing a membership to a hunting club. Here, however, the interest in game management and active participation in practical work should be considered the most important requirement for admission. The right to hunt could be granted to a new member only after the completion of some management assignments by him. For good cooperation it is extremely important that the degree of organization among hunters is high. As in general education, here also the trend is toward the improved circumstance. In 1967, 112,354 (64%) of 174,432 Finnish sportsmen were members of the hunting clubs (The Central Organization of Hunters 1968).

It seems certain that game resources in Finland will not remain at their present level if the number of hunters continues to increase and management efforts do not follow. It is accepted as a fact that in Finland hunting is a privilege rather than a right, but this privilege should be made more easily obtainable for those who are willing to participate actively in game management.

Financing

Financing is an important aspect of game administration. In both Alaska and Finland the funds from hunting license sales are reserved for use in game management (in Alaska they are also used for enforcement and land acquisition). In Alaska an additional important source of revenue is the sale of big game tags. While in Finland there is only one basic hunting license, there are several combination licenses used in Alaska. In Alaska the major portion of the annual expenditures of the Game Division comes from money set aside under the Federal Aid in Wildlife Restoration Act. This aid composed about 80% of the divisional budget for the fiscal year 1969-1970.

In Finland, a few game animals, including moose, are harvested on the basis of a special permit system. The funds collected from moose permit fees are not earmarked for game management, but are partly used to pay compensations for moose damages. Any surplus goes to the general

funds of the state. It has been a major goal of Finnish sportsmen to persuade the representatives in Parliament to take legislative action to limit the use of surplus funds to game management. In 1966, for example, the surplus amount equalled about 30% of the total annual budget of the Finnish game management organization, and was equal to twice the amount appropriated to the State Game Research Institute. At present, the opinion of sportsmen is that the moose permit fee is just an additional indirect tax rather than a contribution to the management of game. This inappropriate use of moose permit funds is one of the major obstacles to better game management in Finland.

Data Collection and Research

In Alaska, most collection of data and material is done by department personnel. This method has many advantages. One reason is that professionals are more competent to gather important descriptive data. Also, if regional data prove to be insufficient, additional collections can be done rapidly and efficiently. This, of course, requires that the departmental staff be large enough to carry out field work efficiently. Thus, it is important that funds be made available for this purpose.

In Alaska, sportsmen contribute to the collection of data mainly by the mandatory return of their harvest tickets, by providing some specimens from animals they kill and by

answering questionnaires. This type of data collection is necessary when much information must be collected during a short period of time and on a statewide basis. In the other sectors of data collection and field studies, the professional staff is able to work efficiently without the assistance of sportsmen. Apparently the wildlife-oriented "reserve" of sportsmen is used only on a limited scale as necessary for the progress of current research programs. Sportsmen form a heterogenous group in Alaska, but it may be worthwhile to investigate the possibility of using them to a greater extent in game management and research.

In addition, much information on Alaskan wildlife is also available from work of the University of Alaska and various agencies of the federal government.

In Finland, most of the material and data are provided to the small research nucleus by an established network of voluntary observers. Among the 180,000 Finnish sportsmen there are about 2,000 persons who regularly receive questionnaires from the State Game Research Institute or other research units. All these persons are well acquainted with the local situations and in addition often have formal training in biology or some related fields. The Finnish professional staff is able to conduct only limited field studies because time and money are limiting factors. The fact that the State Game Research Institute receives only about 15% of the potential game funds limits the scale and

and progress of its various research projects. Recalling the legal and financial status of the Finnish game management system, it is easy to understand why much of its work is based on voluntary cooperation. In general, it is possible to say that the function of the observer system has been efficient enough to provide the research personnel information and material needed. Without this voluntary observer network, game research in Finland would be seriously handicapped, particularly if there were no changes in financing.

The research sector is sometimes not easily distinguishable as a separate entity within the large-scale management programs. If introductions and transplantations are excluded, the major sectors of wildlife research in Alaska consist of (1) the study of relationships between habitat and game populations, (2) habitat manipulation and (3) experiments to detect the harvestability of certain small game populations. On the Kenai National Moose Range a long term study on the moose-range productivity relationship was started in 1968. Habitat manipulations on the Kenai have already led to the introduction of efficient and inexpensive machinery for suppressing unwanted conifers on the areas where moose browse is produced.

In Finland, research and experimentation with the emphasis on practical game management has been limited and largely non-coordinated. The knowledge about habitat im-

provements most appropriate to Finnish conditions has accumulated from observations made in connection with various silvicultural practices. The snow hare has received some special attention as far as winter feeding and sanitary practices are concerned. The results have been encouraging, and the snow hare is now considered to be an easily managed game animal.

The major obstacle to efficient game research in Finland is the lack of funds. Sportsmen have repeatedly requested the initiation of large-scale research in practical management. For this they have asked that the surplus funds from moose permits be permanently earmarked for game management. One game management district has even proposed to turn over their course center to the Central Organization of Hunters to be used as a field station if research financing could be obtained.

The limited experiments carried out by the State Game Research Institute and other research units have been closely related with basic research and have not been directly applicable in the field.

Management Practices

There are current research programs or results of previous works in both Alaska and Finland, which to at least some extent cover all the species included in this study. In Alaska, big game species have received relatively much

more attention than small game species. Ptarmigan have been studied in both states, though in Finland the rock ptarmigan has not been as thoroughly investigated as the willow ptarmigan because of the limited distribution of the former. Hare species have been the subject of intensive attention and practical management in Finland, but in Alaska hare are clearly considered to be reserve species, and research on their biology has started only recently. The muskrat, an introduced species in Finland, has been thoroughly studied. In Alaska, some preliminary surveys and field studies have been conducted. In both Alaska and Finland, however, management of the muskrat has been limited or nonexisting, and this furbearer is underharvested. In Finland the major reason seems to be the lack of interest, and in Alaska the muskrat has a secondary role after more profitable furbearers, because the concentration on muskrat trapping alone is not profitable enough due to the low income from the pelts.

In Alaska, moose have been studied as local population entities. The results of these studies apparently give a somewhat more intensive view than similar ones in Finland, where emphasis has been on nationwide surveys. The Alaskan moose populations have some special problems, for example, migration and concentration into limited wintering areas. In Finland, moose damages on agricultural crops and pine plantations have received special attention.

Controlled hunting is the common management practice in both Alaska and Finland. There are regional or unit-wide regulations in Alaska, and bag limits, when applicable, are defined in these regulations. In Finland, regulations may be provincial or several communes (e.g., in Lapland) may be separated to form a subdistrict. Bag limits are, in the end, determined at the level of the game management association by the local sportsmen themselves.

Habitat improvement in Alaska is still largely in the experimental stage. In Finland the criteria are already established, and much of habitat improvement is accomplished in close association with intensive silviculture. In Alaska, wildfires manipulate habitat to a greater extent than in Finland, but with somewhat similar results. In general, habitat improvement is not necessary in most of Alaska, though it has some importance in the areas where human population density is relatively high, and wildlife resources must be kept at a sufficient level to meet the local hunting pressure. In Finland, habitat improvement is an important method which in association with silviculture has already proved to be an efficient tool of active game management.

In Alaska the emphasis of management is on big game, although basic research on small game has started. On the basis of the size of the state and its low population, more active management of the small game species included in this study is not necessary presently. Basic research,

however, is very important for the anticipation of future needs, when increased sport hunting may require the review of management policy.

In general, Finnish game management has been oriented more towards small game species which can be maintained in densely populated areas. Another reason is that Finland simply does not have a rich big game fauna; moose, the only important species in this category, has therefore received much attention.

Economic Importance

With regard to the economic importance of wildlife resources in general there is a great difference between Alaska and Finland. In Alaska, game meat is very important as food in the remote areas as well as in larger population centers. The number of resident hunters and trappers in 1968 was about 49,000, which is approximately 17% of the population. Based on these figures there was only 0.04 hunters per km^2. During the period from 1964 to 1968 the number of subsistance license holders has been about 5,000 each year. In Finland, where about 180,000 licenses were sold in 1968, the percentage of sportsmen is only 3.8% of the whole population, and there was approximately 0.5 hunters per km^2. Already in 1953 about 77% of Finnish hunters considered themselves as sportsmen, and only less than 12% regarded game as an important part of their family

economy. In Alaska, though the annual moose harvest is roughly as great as in Finland, the number of hunters who share it is only about 1/4 - 1/6 of the number in Finland.

Small game is utilized in different ways in the two states. In Alaska hares and ptarmigan are taken mainly for food, although there has been some increase in sport hunting of these species. In Finland, hares are taken almost exclusively for sport, and only in some rural areas are they important constituents of the diet. Ptarmigan have only local importance, mainly because of their distribution and regional abundance. About 50% of annual harvests is taken in the area where market hunting of these birds is allowed.

Utilization of the muskrat, which is slight in both Alaska and Finland, follows a similar pattern. The income from this resource is shared by a relatively small number of people. In Alaska it is also possible to evaluate the local importance of this furbearer because annual harvests come from a few limited areas.

Hunting associated with tourism is a well-established industry in Alaska. This is shown especially by the increasing sales of non-resident big game tags. Even if the resident population in Alaska increases only slowly, non-resident hunting will definitely become increasingly important.

Despite the fact that tourist hunting is a new phenome-

non in Finland, the beginning has been promising. The future of this new industry depends on effective advertising especially in central Europe and on wider and better game management. The way hunting is organized in Finland prevents significant competition between tourists and resident hunters. For example, it is the decision of hunting clubs whether or not to accept tourist hunters to hunt on their lands. In addition, the limited success of foreign sportsmen in Finland seems to obviate their being serious competition to the Finns. Although game resources are limited, Finland still possesses one very important asset: there are large almost uninhabited areas, which would be "true wilderness" to a tourist hunter from central Europe.

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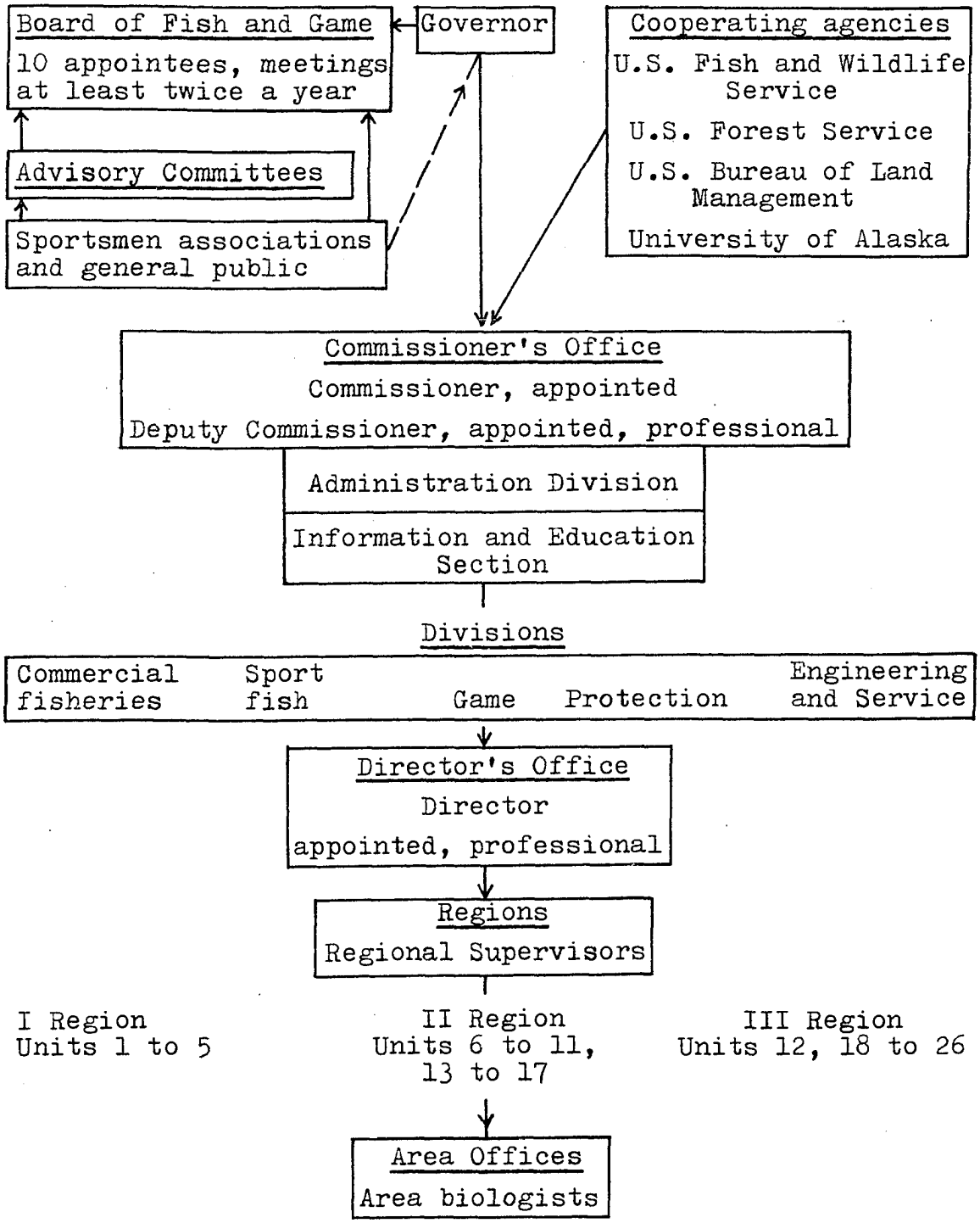
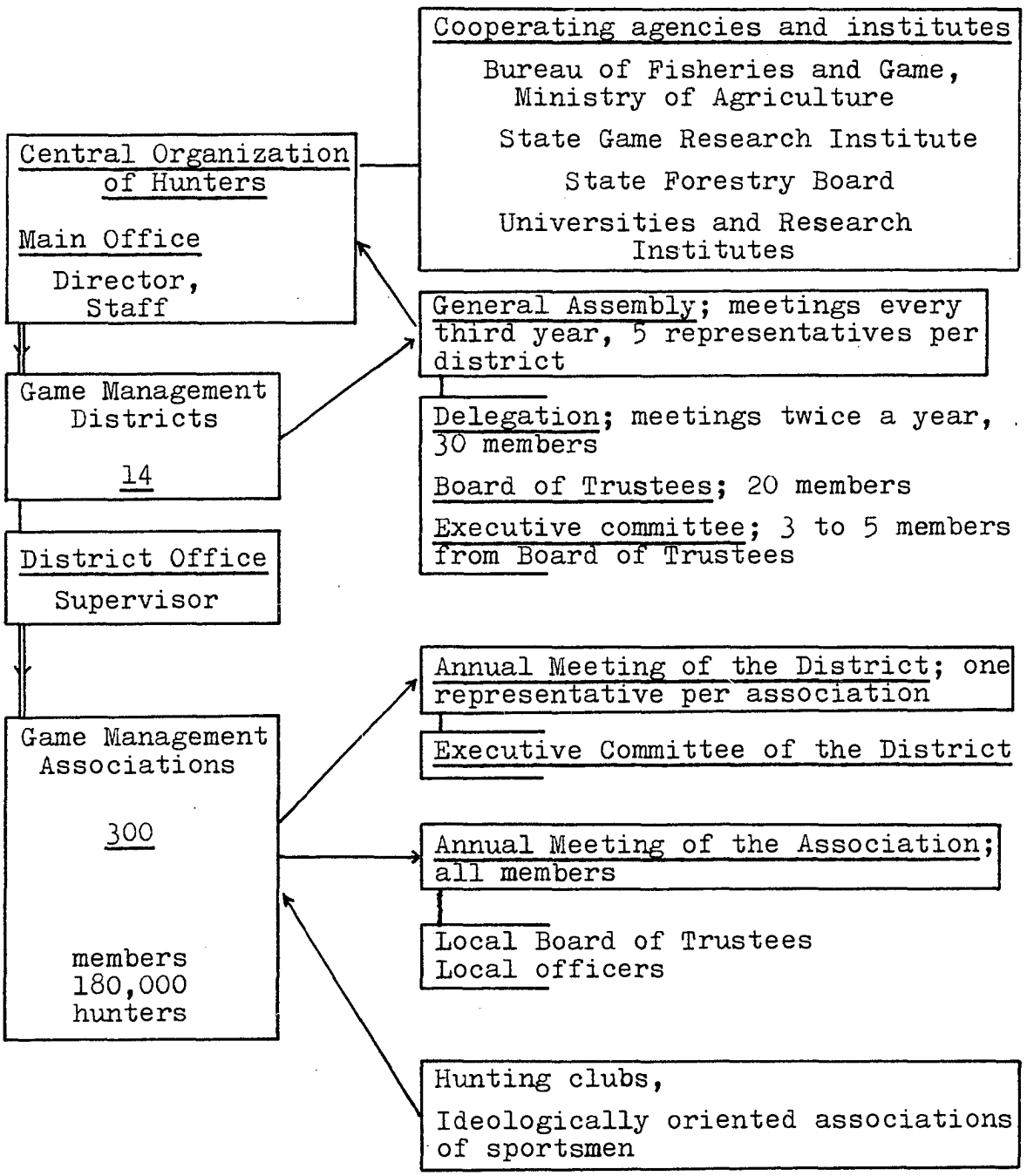
APPENDIX

I. The Organization of the Alaska Department of Fish and Game.



II. The Finnish Game Management Organization; based on the voluntary cooperation of the hunters.



III. Auto-animal collisions in Alaska from 1960 through 1968, excluding the areas of population centers with 2,500 or more people, compiled by the Alaska Department of Highways.

	1960	61	62	63	64	65	66	67	1968
Fatal accidents	1			1					
Property damage	43	63	52	70	81	72	61	64	94
Injury	14	24	26	14	25	32	31	28	27
Total no. of accidents	58	87	78	85	106	104	92	92	121